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N. N. Smirnov

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FAUNA OF THE U.S.S.R.

(Fauna SSSR)

CRUSTACEA

(Rakoobraznye)

Volume 1, No.2

N. N. Smirnov

CHYDORIDAE

(Chydoridae fauny mira)

Chief editor: B.E.Bykhovskii
Editorial board: I.M.Gromov, A.S.Monchadskii, A.A.Shtakel'berg,
O.A.Skarlato, and A.A.Strelkov (Volume editor)

Izdatel'stvo "Nauka"
Leningradskoe Otdelenie
Leningrad, 1971

Translated from Russian

Israel Program for Scientific Translations
Jerusalem 1974

The Publication of this Translation
was Supported by
THE UNITED STATES–ISRAEL
BINATIONAL SCIENCE FOUNDATION

Copyright © 1974
Keter Publishing House Jerusalem Ltd.
Cat. No.61018 8

ISBN 0 7065 1362 2

Translated by A. Mercado
Edited by Prof. O. Theodor

Printed in Jerusalem by Keter Press
Binding: Wiener Bindery Ltd., Jerusalem

Available from the
U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
Springfield, Va. 22151

XII/7/3

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3 FOREWORD

The Chydoridae, the largest family of the order Cladocera, is clearly defined morphologically and ecologically. The species of this family are abundant in the littoral of freshwater bodies and are an important food object for many fishes. Some Chydoridae can be bred for food in fish breeding. The Chydoridae are also guide forms for the history of lakes, because their numerous remains are well preserved in sediments and can be determined to the species (Frey, 1958, 1959, 1960, 1961a, 1962a, 1962b; Korde, 1960).

The regional character of the studies published in the past was a major obstacle when determining the Chydoridae. Brehm (1957:229) stated that the available keys only applied to restricted areas and obviously did not cover all known species and that as a result numerous doubtful new species had been described.

Research of the Chydoridae began with mainly taxonomic studies (O.F. Müller, 1776, 1785; Jurine, 1820; Baird, 1834, 1843, 1850; Lilljeborg, 1853, 1887, 1900; Leydig, 1860; Sars, 1862a, etc.). These authors classified the Chydoridae mainly on the basis of external characters. The only exception is the work of Leydig (1860), which contains numerous data on internal morphology.

Baird (1850) named this family Lynceidae, and this name was used until 1900 (Lilljeborg, 1900). When the name Lynceus was given to a genus of Conchostraca, Stebbing (1902) suggested replacing Lynceidae by Chydoridae, which is the name used at present.

O.F. Müller (1776) established the genus Lynceus. He not only placed in it the Chydoridae but also species now placed in other families. Leach (1816) distinguished two genera, Lynceus and Chydorus. Baird (1843) divided the genus Lynceus into 8 subgenera: Macrothrix (now the family Macrothricidae), Eurycercus, Chydorus, Camptocercus, Acroperus, Alona, Pleuroxus, and Peracantha. Sars (1862a) recognized 13 genera: Chydorus, Pleuroxus, Alona, Camptocercus, Anchistropus, Alonella, Harporhynchus, Monospilus, Eurycercus, Alonopsis, Peracantha, Graptoleberis, and Acroperus. The review of Lilljeborg (1900) contains the above genera and also the genus Leydigia Kurz (1875) (Alona appears in Lilljeborg's review under the name of Lynceus). Dybowski and Grochowski (1894) established several genera, of which Kurzia and Oxyurella have been accepted. Sars (1901) established the genera Euryalona, Dadaya, and Leydigiopsis. Birge (1910 : 1050) commented on the unsatisfactory diagnosis of the genera of the Chydorinae, and stated that this state of affairs will become increasingly serious as the number of species increases.

Kurz (1875) established two subfamilies in the family Chydoridae: Chydorinae, which includes all genera except Eurycercus; Eurycercinae, which contains only the genus Eurycercus.

Dybowski and Grochowski (1894) distinguished four groups of genera in the family Chydoridae: Eurycercinae Kurz, 1875 (Eurycercus); Acroperinae (Camptocercus and Acroperus); Aloninae (Alonopsis, Kurzia, Leydigia, Coronatella Dybowski and Grochowski, 1894 (syn. Alona coronata Kurz), Oxyurella, Alona, Harporhynchus, and Graptoleberis; Pleuroxinae (Landea Dybowski and Grochowski, 1894, Lynceus (Disparalona rostrata Koch), Peracantha, Alonella, Pleuroxus (Pleuroxus hastatus Sars, etc.), and Rhypophilus (Pleuroxus personatus Schödler)); Chydorinae (Chydorus and Monospilus). Dybowski and Grochowski (1895) established the family Eurycercidae Dybowski and Grochowski, 1895, and the family Lynceidae Baird with 6 groups of genera: Acroperinae Dybowski and Grochowski, 1894 (Acroperus and Camptocercus); Lynceinae P.E. Müller (Alonopsis, Kurzia, Alona, Leydigia, Coronatella, Oxyurella, Harporhynchus, and Graptoleberis); Lyncopleuroxinae Dybowski and Grochowski, 1895 (Landea and Lynceus); Pleuroxinae Dybowski and Grochowski, 1894 (Alonella, Pleuroxus, Peracantha, and Rhypophilus); Chydorinae Dybowski and Grochowski, 1894 (Chydorus); Monospilinae Dybowski and Grochowski, 1895 (Monospilus). On the basis of a new character, the head pores, Frey (1959) divided the genera of the Chydoridae into four sections: Eurycercus, Alona, Chydorus, and Monospilus. Frey (1967) established the four subfamilies which are accepted in the present work. Various authors (Bening, 1941; Herbst, 1962; Šrámek-Hušek et al., 1962; Manuilova, 1964) changed the arrangement of the genera but gave no explanation for the changes.

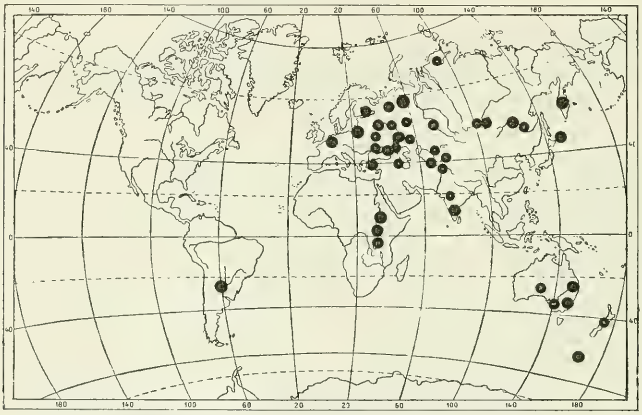

FIGURE 1. Localities of the material examined by the author

We have revised the classification of the Chydoridae on the basis of fresh material (Figure 1), an examination of the types and a study of the literature. Our material was collected from the Volga from Kalinin to the delta, from the Cherepovets and Kama reservoirs, and from water bodies in the Moscow Region, Crimea, and Baikal. The scope of our work was greatly increased both taxonomically and geographically by further material placed at our disposal by the following colleagues: I. N. Andronnikova (Karelian Isthmus), V. N. Baturina (Orenburg), E. V. Borutskii (Amur Basin, Kunashir Island), G. L. Vasil'eva (Lake Baikal, Baikal area), L. M. Ermolaeva (Omsk Region), L. N. Zimbalevskaya (Ukraine), V. K. Iz"yurova (Komi ASSR), M. M. Kozhov (Baikal), I. I. Kurenkov (Kamchatka), S. M. Lyakhov (who sent several preparations of S. M. Shikleev), E. F. Manuilova (Lake Issyk-Kul' and vicinity), G. F. Mazepova (Baikal), A. V. Monakov (White Nile River), O. N. Nasukhov (Terek Delta), N. V. Pridatkina (ponds near Tashkent), G. M. Pyatakova (Lenkoran' — Astara), T. V. Sklyarova (drawings), E. F. Titarev (Altai Territory), L. M. Trofimova (Stavropol' Territory), B. M. Chirvinskaya (Perm Region), A. P. Falomeeva (Kazakhstan), N. S. Yalynskaya (who provided some types of Dybowski and Grochowski), A. I. Yankovskaya (Pamir, southwestern Kyzylkum), M. H. Barclay (New Zealand), M. Straškraba (Prague, Czechoslovakia, records from Cuba), A. D. M. de Ferrato (Argentina), V. H. Jolly (Australia), C. Kosswig, Hamburg (material from Turkey), P. Leentvaar (Holland), J. Rzóska, London (western Sudan, White Nile), B. V. Timms (Australia), and many others. We are also indebted to the Zoological Museum of the Academy of Sciences of the USSR, the Zoological Museum of Moscow State University, the Zoological Museum of L'vov State University, and the British Museum (Nat. Hist.) for placing their material at our disposal.

5 The drawings were made with a camera lucida. The numbers of the balsam preparations are indicated on the drawings. The preparations are deposited at the Zoological Museum of Moscow State University (MGU), the Zoological Institute of the Academy of Sciences of the USSR (ZIN), the Biological-Geographical Institute of Irkutsk State University (BGI), and the Philadelphia Academy of Natural Sciences, (C. E. Goulden). All preparations, including holotypes and paratypes, are total preparations in Canada balsam.

We gratefully acknowledge the receipt of old, rare publications from J. Rzóska (London), D. G. Frey (Bloomington, U. S. A.), G. Fryer (Freshwater Biological Association, Great Britain), J. P. Harding (London), H. Hoestlandt (Lyon, France), and the library of the Freshwater Biological Association, Great Britain.

The present work was carried out mainly at the Zooplankton and Zoobenthos Laboratory of the Institute of Inland Water Biology of the Academy of Sciences of the USSR (Director: Professor F. D. Mordukhai-Boltovskoi) from 1959 to 1966 and was completed at the Institute of Evolutional Morphology and Ecology of Animals of the USSR Academy of Sciences. We received valuable advice from Professor E. V. Borutskii of the MGU Zoological Museum. We are also grateful to Professor A. A. Strelkov of the Zoological Institute of the USSR Academy of Sciences for his comments.

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16. Genus *Camptocercus* Baird, 1843

1. *C. rectirostris* Schoedler, 1862 429
    1a. *C. rectirostris rectirostris* Schoedler, 1862 430
    1b. *C. rectirostris biserratus* Schoedler, 1862 434
    1c. *C. rectirostris šiklejevi* Šrámek-Hušek, 1962 434
    1d. *C. rectirostris serratunguis* Chiang-Sieh-chih, 1964 comb. n. 434
2. *C. fennicus* Stenroos, 1898 436
3. *C. australis* Sars, 1896 436
4. *C. uncinatus* N. N. Smirnov sp. n. 436
5. *C. lilljeborgi* Schoedler, 1862 438
    5a. *C. lilljeborgi lilljeborgi* Schoedler, 1862 438
    5b. *C. lilljeborgi dadayi* Stingelin, 1913 438
6. *C. rotundus* Herrick, 1882 438
7. *C. aloniceps* Ekman, 1900 438
8. *C. oklahomensis* Mackin, 1930 442

Incertae sedis 443

17. Genus *Graptoleberis* Sars, 1862

1. *G. testudinaria* (Fischer, 1851) 443
    1a. *G. testudinaria testudinaria* (Fischer, 1851) 444
    1b. *G. testudinaria occidentalis* Sars, 1901 446
    1c. *G. testudinaria slovenica* Šrámek-Hušek, 1962 446
    1d. *G. testudinaria pannonica* Daday, 1904 449
    1e. *G. testudinaria orientalis* Daday, 1910 449

Nomina nuda 449

18. Genus *Leydigia* Kurz, 1875

1. *L. leydigi* (Schoedler, 1863) 450
2. *L. macrodonta* Sars, 1916 454
    2a. *L. macrodonta macrodonta* Sars, 1916 454
    2b. *L. macrodonta louisi* Jenkin, 1934 454
3. *L. ciliata* Gauthier, 1939 454
4. *L. laevis* Gurney, 1927 458
5. *L. acanthocercoides* (Fischer, 1854) 458
6. *L. microps* Sars, 1916 460
7. *L. propinqua* Sars, 1903 460
8. *L. schubarti* Brehmet Thomsen, 1936 462
9. *L. trichura* Fordyce, 1904 462
10. *L. australis* Sars, 1885 462
    10a. *L. australis australis* Sars, 1886 463
    10b. *L. australis ceylonica* Daday, 1898 463
11. *L. ipojucae* Brehm, 1938 463

12. *L. fimbriata* Fordyce, 1901 463
Incertae sedis 465

19. Genus *Biapertura* N. N. Smirnov gen. n.

1. *B. affinis* (Leydig, 1860) comb. n. 467
    1a. *B. affinis affinis* (Leydig, 1860) comb. n 467
    1b. *B. affinis ornata* (Stingelin, 1895) comb. n. 472
    1c. *B. affinis elegantula* (Brehm, 1933) comb. n. 472
    1d. *B. affinis barbata* (Brehm, 1935) comb. n. 472
    1e. *B. affinis dentata* (Werestschagin. 1911) comb. n. 472
2. *B. kendallensis* (Henry, 1919) comb. n. 474
3. *B. longinqua* N. N. Smirnov sp. n. 474
4. *B. intermedia* (Sars, 1862) comb. n. 475
    4a. *B. intermedia intermedia* (Sars, 1862) comb. n. 475
    4b. *B. intermedia minor* (Stingelin, 1905) comb. n. 475
5. *B. rigidicaudis* N. N. Smirnov sp. n. 475
6. *B. karua* (King, 1853) comb. n. 479
7. *B. pseudoverrucosa* N. N. Smirnov sp. n. 480
    7a. *B. pseudoverrucosa pseudoverrucosa* N. N. Smirnov ssp. n. 480
    7b. *B. pseudoverrucosa verrucosa* (Sars, 1901) 480

20. Genus *Tretocephala* Frey, 1965

1. *T. ambigua* (Lilljeborg, 1900) 484
2. *T. colletti* (Sars, 1895) 487

21. Genus *Rhynchotalona* Norman, 1903

1. *Rh. falcata* (Sars, 1862) 490
Incertae sedis 491

22. Genus *Oxyurella* Dybowski et Grochowski, 1894

1. *O. tenuicaudis* (Sars, 1862) 493
2. *O. ciliata* Bergamin, 1939 493
3. *O. longicaudis* (Birge, 1910) 496
4. *O. wallaciana* (Henry, 1919) 496
5. *O. singalensis* (Daday, 1898) 497
Nomina nuda 497

23. Genus *Euryalona* Sars, 1901

1. *E. orientalis* (Daday, 1898) 498
2. *E. fasciculata* Daday, 1905 501
3. *E. brasiliensis* Brehm et Thomsen, 1936 501

24. Genus *Indialona* Petkovski, 1966

1. *I. ganapati* Petkovski, 1966 502
2. *I. annandalei* (Daday, 1908) comb. n. 502
3. *I. globulosa* (Daday, 1898) comb. n. 504
    3a. *I. globulosa globulosa* (Daday, 1898) 504
    3b. *I. globulosa insulcata* (Stingelin, 1905) 505
4. *I. macronyx* (Daday, 1898) comb. n. 505

25. Genus *Monospilus* Sars, 1862

1. *M. dispar* Sars, 1862 505
Nomen nudum 509

26. Genus *Leydigiopsis* Sars, 1901

1. *L. curvirostris* Sars, 1901 511
2. *L. brevirostris* Brehm, 1938 511
3. *L. megalops* Sars, 1901 511
4. *L. ornata* Daday, 1905 511

MORPHOLOGY

EXTERNAL MORPHOLOGY

The length of the body is usually greater than the height and may be about double (Figures 183, 291, and 512). Chydoridae vary in length from 0.2 to 6 mm. The longitudinal axis of the body is held parallel to the substrate, on which the animals usually crawl. The integument is chitinous and varies in thickness according to the area of the body. The valves, head shield, postabdomen, and legs II have a relatively thick integument; the other legs and the body are covered with a thin elastic membrane. The molting animal sheds the head shield, the valves, the integument of the postabdomen, abdomen, and mouth parts, and also the thin integument of all legs, including the smallest details.

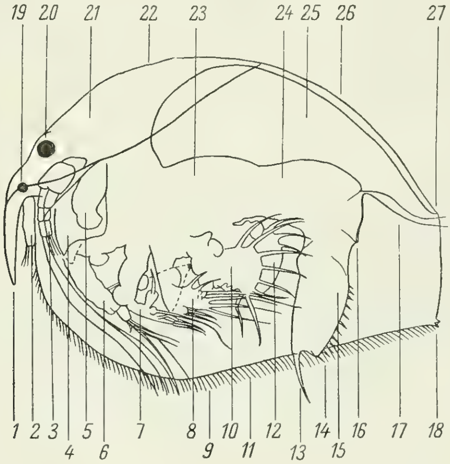

FIGURE 2. Morphology of Chydoridae. Example: Pleuroxus trigonellus (Rybinsk Reservoir, 7 December 1962, length 0.68 mm):

1—rostrum; 2—antennule (antenna I); 3—antenna (antenna II); 4—labral plate; 5—mandible; 6—leg I; 7—leg II; 8—leg III; 9—ventral margin of valve; 10—leg IV; 11—setae on ventral margin of valve; 12—leg V; 13—claw; 14—anal denticle; 15—postabdomen (cauda, abreptor); 16—preanal corner; 17—natatorial setae; 18—posteroventral corner of valve, with denticles; 19—ocellus (pigment spot); 20—eye; 21—head shield; 22—head pores; 23—thorax; 24—abdomen; 25—brood pouch; 26—dorsal margin; 27—posterodorsal corner of valve.

13 The body of the Chydoridae consists of a head which bears one pair of antennules (first pair of appendages, or first pair of antennae) and one pair of antennae, the thorax with 5 or 6 pairs of legs, and a postabdomen (Figure 2). The standard measurements are indicated in Figures 3 and 4. The head is covered by the head shield, which adjoins the bivalve carapace. The head shield is closely adjacent to the head. Below the posterior part of the head shield are inserted the muscles of the antennae and mandibles; the heart is also situated here. A suture divides the head shield from the valves. The suture is not always visible, and the above parts become separated only during the molt. The head shield may be rounded or produced into a pointed rostrum anteroventrally (Figures 5 and 6). The rostrum may be short or long, directed posteroventrally or sometimes curved anteriorly and dorsally into a hook (Figure 6). The posterior margin of the head shield may be rounded or angular. The lateral keel of the head, which begins as a margin of the head shield above the base of the antennae, is named the fornix. The fornix may or may not reach to the apex of the rostrum. The cephalic and dorsal keels of some species of the genera Acroperus and Camptocercus are well developed in the form of a transparent plate. The posterior part of the head shield bears pores, the form and arrangement of which have become an important character for the establishment of subfamilies (Frey, 1959, 1962a).

The valve has a dorsal, a ventral, an anterior, and a posterior margin. The posterior margin converges with the dorsal margin and forms the posterodorsal corner; it forms the posteroventral corner with the ventral margin (Figure 7). These two corners may be pointed or rounded. Denticles may be present where the posterior and ventral margins meet. The number and, to some extent, the form of the denticles vary markedly; however the form of the denticles is a specific character. The ventral margin of the valve passes smoothly into the anterior margin. The anterior margin may be denticulate. The ventral and anterior margins bear setae. The setae begin from the inner side of the valve in the posterior half of the ventral margin in some Chydorinae and Aloninae. The inner side of the posterior margin may bear a row of small premarginal hairs.

The valve may have no distinct structure, but it is sometimes marked with anastomosing lines or with a reticulate pattern or pits (Figure 8). The intervals between the lines vary, and there may be fine striation between the lines which may be polygonal. The dorsal surface is ciliated in Chydorus ciliatus. The valves bear lateral processes in Pleuroxus pamirensis and Chydorus bicornutus (Figure 104). Some species of the genera Pleuroxus, Chydorus, Alonella, Alona, and Biapertura include forms with a smooth and a tuberculate pitted shell.

The head bears the antennules and the antennae. The antennules are paired appendages of the anterior side of the head (Figures 9 and 10). The form of the antennules and their length in relation to the apex of the rostrum vary in the different species. The antennules bear esthetascs (sensory papillae) and sensory setae. The antennules of the males differ distinctly from those of the females. The lateral seta may be situated directly on the antennule or on a tubercle on its surface (e.g., Dunhevedia).

The antennae are paired appendages of the posterior side of the head. They consist of a 2-segmented base and two 3-segmented rami. The base is partly covered by the fornices. The basal segments are short. The segments of the rami are short or long cylinders. The ratio of their width to their length varies from 1 to 4 in the different species. The basal segments are slightly larger than the terminal segments. The first segment of the endopodite in Rhynchotalona falcata is very wide (Figure 10). The segments of Eurycercus bear rows of spinules. Similar but less developed rows of spinules are present on the antennal segments of some species of Pleuroxus. The segments have a smooth surface in the other genera. The first segment bears two setae which consist of two parts situated below the fornix. These sensory setae were described for Alona protzi (Gurney, 1921) and Eurycercus lamellatus (Fryer, 1963b). We found them in many species (Figure 208, and others). The second segment may bear a spine. The segments of the rami may bear setae and spines. The distal segment of both rami always bears 3 setae. The basal (first) segment of the rami often lacks setae. There is usually only one spine on a segment, although they are numerous in Leydigia. The arrangement of setae on the antennal segments can be expressed by a formula. The numerator of this formula indicates the number of setae on the segments of the endopodite and the denominator the number of setae on the exopodite. The exopodite or lower ramus is situated below when the antenna is directed posteriorly; it becomes outer or anterior when the antenna is directed ventrally. The count of the setae on the segments begins from the first (basal) segment and proceeds to the second and third segments from the left to the right. A formula of the spines on the antennae can be obtained in a similar manner.

The mouth parts include mandibles (Figure 11), maxillules, paragnaths, labrum, and labium. The mandible comprises a masticatory plate (gnathobase) the form of which differs on the left and right side. The right mandible of Eurycercus lamellatus has a cup-shaped gnathobase, and the left mandible bears denticles directed anteriorly. The articulation of the man-
18 dibles with the head shield (Figure 12) may be of two types (Frey, 1967a). In Eurycercus and in the Aloninae the pointed base of the mandible articulates with the integument at the border between the head shield and the valve, which are thickened at this point. Saycia has a similar articulation of the mandibles. Another type of articulation is present in the Chydorinae; the pointed base of the mandible is situated here on the inner side of the head shield some distance from the margin, and the mandible articulates with a thin fold of the integument. In contrast to the preceding type, the head shield and valves are not thickened at the margin.

The maxillules and paragnaths are situated behind the mandibles. The paragnaths are plates situated lateral to the setae of the maxillules. The labrum (epistome) is situated before the mouth and the gnathobase of the mandibles. The anterior part of the labrum is ciliated at the entrance to the esophagus. The labrum usually bears a more or less developed plate-shaped process. This process may be rounded or angular, sometimes with

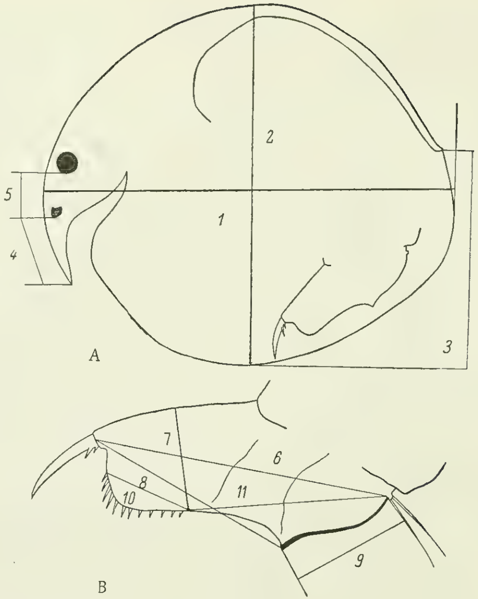

FIGURE 3. Diagram of measurements:

A—general view; B—postabdomen. 1—length; 2—height; 3—height of posterior margin of valve; 4—distance from ocellus to apex of rostrum; 5—distance from ocellus to eye; 6—length of postabdomen; 7—height of postabdomen; 8—distance from base of claw to preanal corner (length of distal part of postabdomen); 9—distance from preanal corner to base of natatorial setae (length of preanal part of postabdomen); 10—length of row of anal denticles; 11—distance from base of natatorial setae to proximal anal denticle.

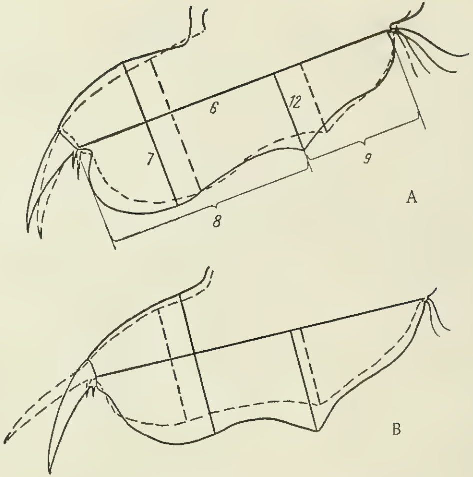

FIGURE 4. Comparison of postabdomen (after Jenkin, 1934):

6—length of postabdomen; 7—height of postabdomen; 8—length of postanal part of postabdomen; 9—length of preanal part of postabdomen; 12—depth of preanal corner. A: continuous line —Biapertura pseudoverrucosa verrucosa, broken line — Alona rectangula novae-zealandiae; B: continuous line — A. macrocopa, broken line — A. bukobensis.

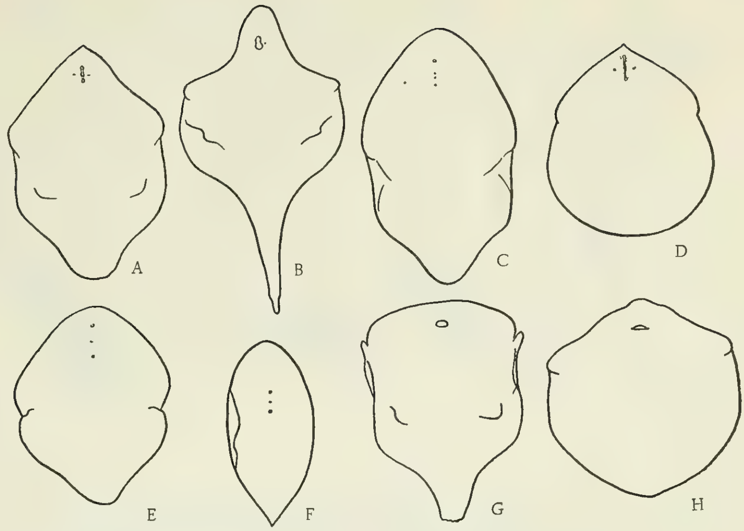

FIGURE 5. Head shields:

A—Alona quadrangularis; B—Rhynchotalona falcata; C—Oxyurella tenuicaudis (after Frey, 1960); D—Graptoleberis testudinaria; E—Dunhevedia crassa; F—Pleuroxus striatus, shield of exuvia of stage VII; G—Monospilus dispar; H—Eurycercus lamellatus (A, B, D, E, G, H — after Frey, 1962a). Apex of rostrum directed downward.

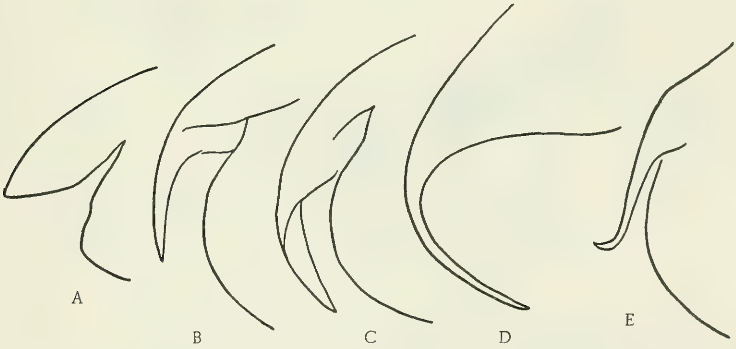

FIGURE 6. Rostrum, lateral view:

A—Acroperus elongatus; B—Pleuroxus trigonellus; C—P. striatus; D—Rhynchotalona falcata; E—Pleuroxus uncinatus.

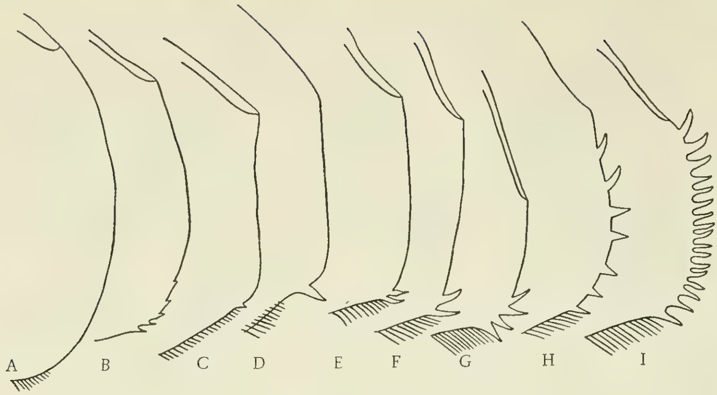

FIGURE 7. Posterior margin of valves:

A—Alona costata; B—Camptocercus rectirostris; C—Pleuroxus striatus; D—Dunhevedia crassa (after Bening, 1941); E—Pleuroxus aduncus; F—P. uncinatus; G—P. uncinatus (after Lilljeborg, 1900); H—P. procurvus (from Brooks, 1953); I—P. truncatus. The posteroventral corner is absent in A and B, present in C, without denticles in A, with terminal denticles in B, E, F, and G, with subterminal denticles in C and D. The posterodorsal corner is absent in A, present in B — I.

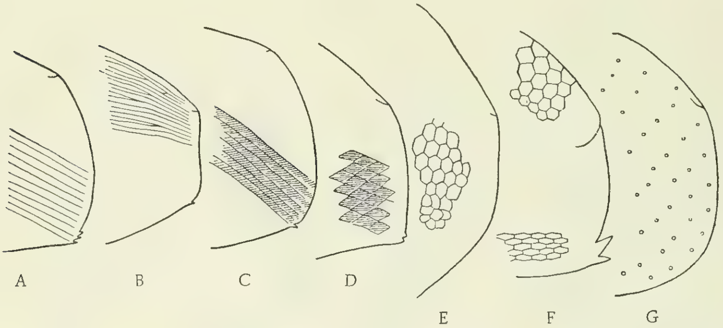

FIGURE 8. Pattern on valve of females:

A—Acroperus harpae; B—Pleuroxus striatus; C—Acroperus elongatus; D—Alonella excisa; E—Pseudochydorus globosus; F—Graptoleberis testudinaria; G—Alona guttata (after Lilljeborg, 1900). A, C — parallel lines; B — anastomosing lines; D, E, F — cells; G—pits.

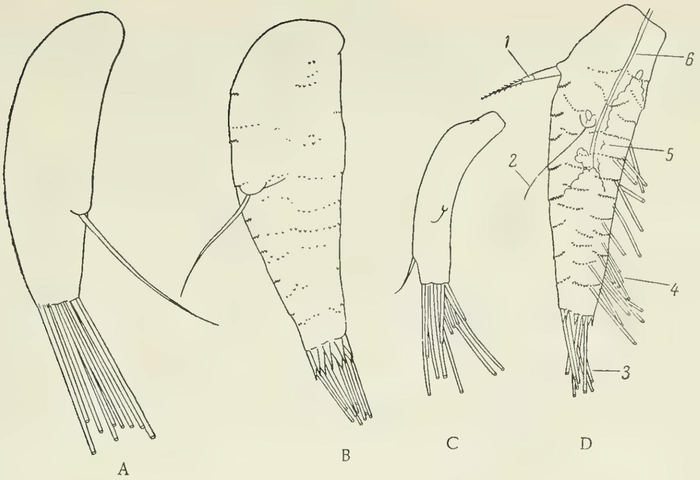

FIGURE 9. Antennules:

A—Leydigia leydigi, female; B—Eurycercus lamellatus, female; C—Camptocercus lilljeborgi, male; D—Eurycercus lamellatus, male. 1 — 3-segmented sensory seta; 2 — one-segmented sensory seta; 3 — distal sensory papillae; 4 — lateral sensory papillae; 5 — ganglionic masses; 6 — nerve.

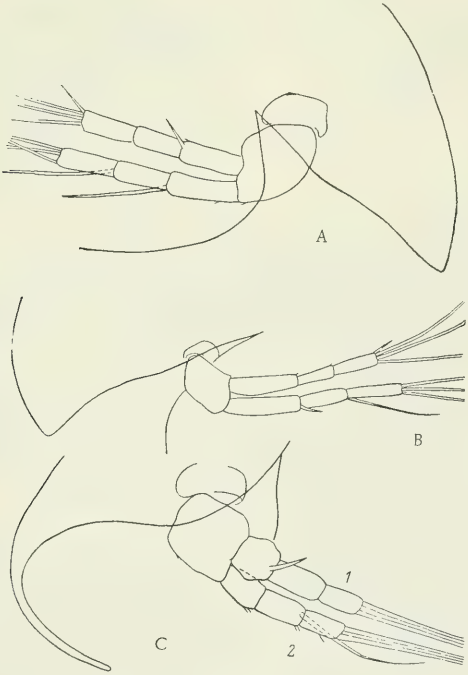

FIGURE 10. Antenna of female:

A—Acroperus elongatus; B—A. harpae; C—Rhynchotalona falcata. 1 — endopodite; 2 — exopodite.

a prolonged and pointed ventral margin (Figure 13). The anterior margin of the plate of the labrum (anterior functionally) may be smooth, undulate or denticulate. The plate-shaped process is almost absent in *Pseudochydorus globosus*. The labium has no appendages.

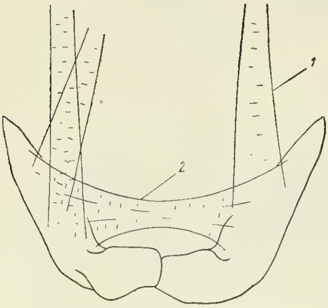

FIGURE 11. *Alona guttata guttata*, female, mandibles, dorsal:

1—mandibular muscles; 2—transverse muscles of mandible (Lake Seito, Arkhangelsk Region).

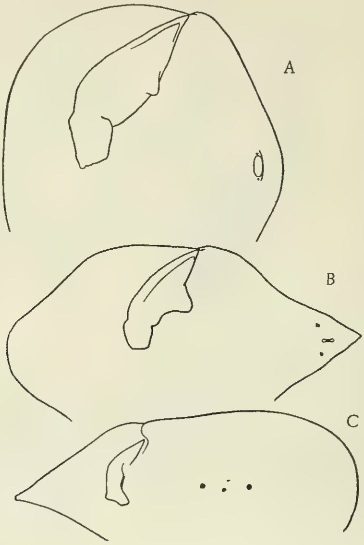

FIGURE 12. Articulation of mandibles with the integument:

A—*Eurycercus lamellatus* (after Frey, 1967a); B—*Biapertura affinis* (after Frey, 1967a); C—*Chydorus sphaericus* (Lake Kadil'noe, Baikal coast, east of Bol'shie Koty, 21 August 1964, preparation 1599).

The leg-bearing part of the body is the thorax. The term abdomen refers to that part of the body behind the legs to the bent part. The abdomen is usually short, but it is very long in *Camptocercus*. The integument of the abdomen is thin and elastic; it forms folds ventrally when the postabdomen is curved. In some specialized Aloninae (*Acroperus*, *Camptocercus*, and *Monospilus*), the abdominal wall bears on each side a chitinized thickening or apodeme whose distal end bears a thick fulcrum (Figures 14—24). An area of soft cuticle extends between the fulcrum and the hard postabdomen. The skeletal formations in the integument of the posterior part of the abdomen are hardly developed or absent in *Alona*, *Graptoleberis*, *Leydigia*, *Biapertura*, *Indialona*, *Oxyurella*, *Rhynchotalona*, and in all Chydorinae. There are several segments in the posterior half of the abdomen. The posterior segments are slightly invaginated into the anterior segments and form characteristic folds at the border between the segments in lateral view. The folds usually bear setae. These rows of setae are clearly visible in dorsal view (Figure 18); in lateral view, each row appears as a single seta. The form of the folds depends on the position of the postabdomen (Figures 16—18). The dorsal side of the abdomen of the mature female of Eurycercus lamellatus bears a process which closes the brood pouch (Figure 82).

The posterior part of the body (postabdomen) is curved anteroventrally so that the morphologically dorsal side becomes ventral. The postabdomen 19 is distinctly flattened laterally into a plate and is usually strongly chitinized. Its morphological dorsal side bears a proximal tubercle with two setae; these are called natatorial setae. The postabdomen has a ventral, a dorsal, and a posterior margin (Figure 26). The dorsal margin may be divided into a preanal margin (from the base of the natatorial setae to the anus), an anal margin (around the anus), and a postanal margin. The postabdomen varies greatly in structure (Figures 25—28). It ends in two claws (furca) which may bear 1—2 basal spines (Figure 29). The female of Oxyurella singalensis has more than two basal spines. The furca is movable at the base. When the postabdomen returns to its normal position between the legs, the furca may adhere to the setae of the valves and legs, and it may then be extended again (as we observed in live Pleuroxus aduncus, Alonella excisa, etc.). The postabdomen contains the posterior part of the intestine and the anus. The anus of Eurycercus is situated distally, while in all other Chydoridae it is situated dorsally in the proximal part of the postabdomen. The dorsal margin of the postabdomen bears a double row of denticles (postanal denticles) distal to the anus. Most species have no denticles proximal to the anus, but there is a long row of numerous preanal denticles in Eurycercus. The number of postanal denticles on one side varies from a few to 65 in Camptocercus. Both sides of the postabdomen may bear lateral setae or spinules, usually in tufts. The number and size of the anal denticles is usually smaller in the male than in the female. The adult males of many Chydoridae have no anal denticles.

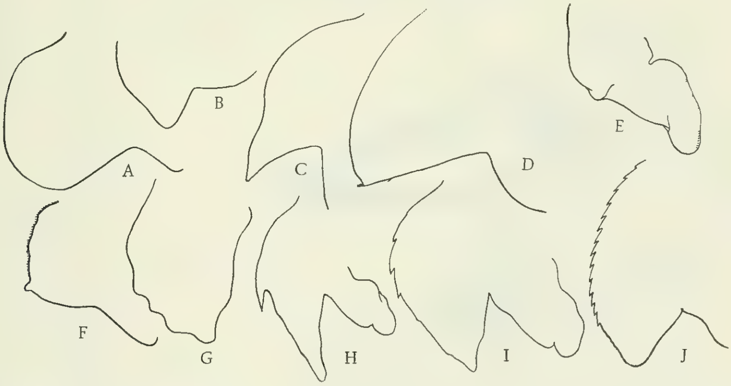

FIGURE 13. Plate of labrum:

A—rounded (Oxyurella tenuicaudis); B—triangular with rounded apex (Acroperus elongatus); C—triangular with pointed apex (Chydorus sphaericus pectinatus); D—triangular with apical setae (Camptocercus lilljeborgi); E—labrum with little developed plate (Pseudochydorus globosus globosus, Cherepovets Reservoir, 9 October 1963); F—rounded, ciliated (Leydigia leydigi); G—with undulate margin (Alona inkiti, after Shikleev, 1929); H—with one denticle (Chydorus brevidentatus, White Nile, 19 April 1964); I—with a few denticles (Chydorus barroisi; Prospect Reservoir, Sydney, New South Wales, Australia, 2 May 1963); J—serrated (Dunhevedia serrata, after Harding, 1957b).

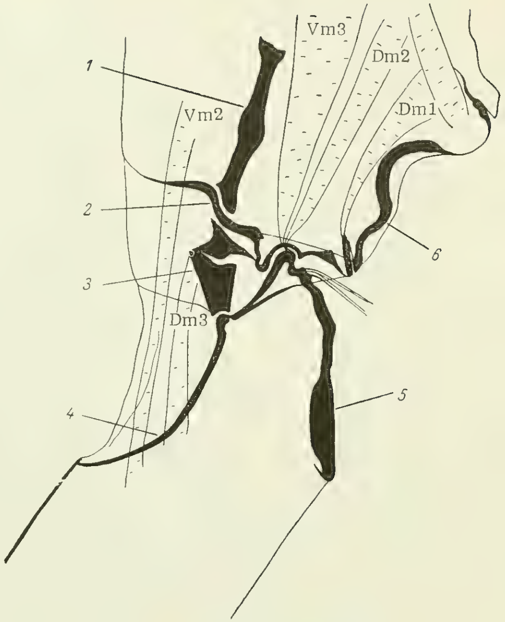

FIGURE 14. Skeletal elements and articulation of postabdomen of female of Acroperus alonoides (Cherepovets Reservoir, mouth of Kovzha River, 16 September 1963). Length of apodema 48μ:

Dm—dorsal muscles; Vm—ventral muscles; 1—apodeme; 2—fulcrum; 3—intermediate sclerite; 4—annular sclerite of proximal part of postabdomen; 5—sclerite of preanal side of postabdomen; 6—sclerite of penultimate abdominal segment.

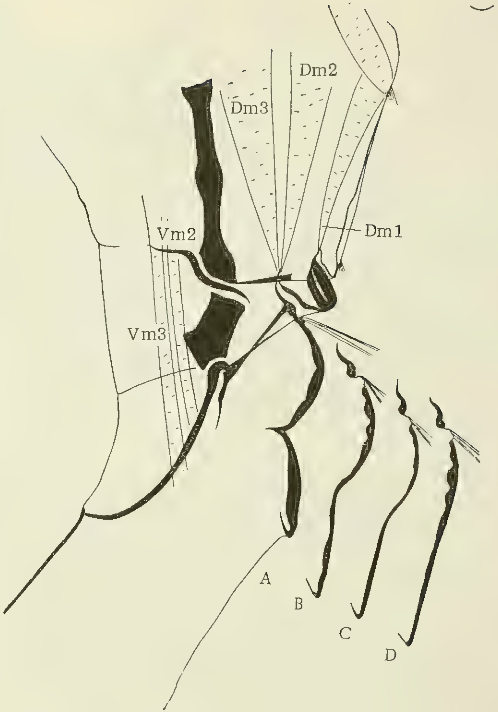

FIGURE 15. Skeletal elements and articulation of postabdomen of male of Acroperus alonoides (Cherepovets Reservoir, 16 September 1963). Length of apodeme 40μ:

A - general view, left side; B-D-preanal margin of the postabdomen of other specimens.

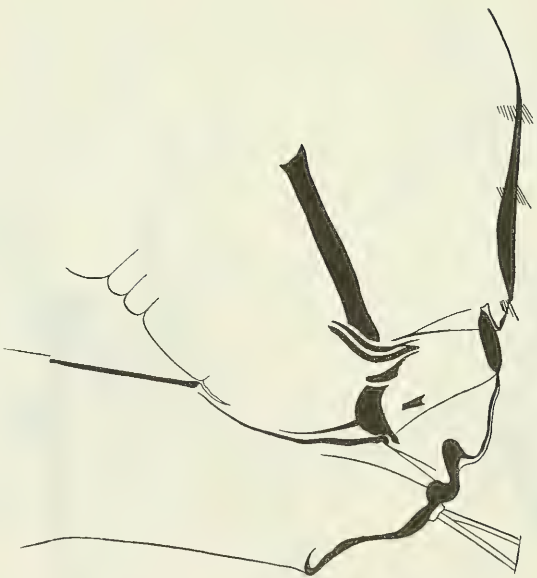

FIGURE 16. Articulation of postabdomen of female of Acroperus elongatus (found in a curved position) (Rybinsk Reservoir, 13 June 1961). Length of apodeme 78 μ.

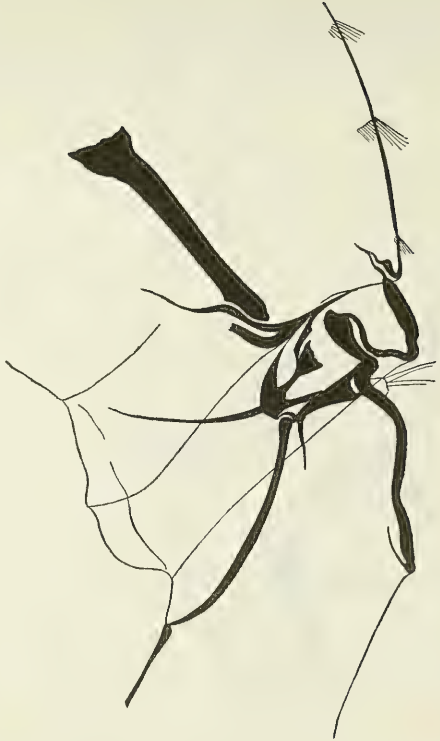

FIGURE 17. Articulation of postabdomen of female of Acroperus elongatus (intermediate position) (Uglich Reservoir, 23 July 1962). Length of apodeme 77 μ.

(22, 23)

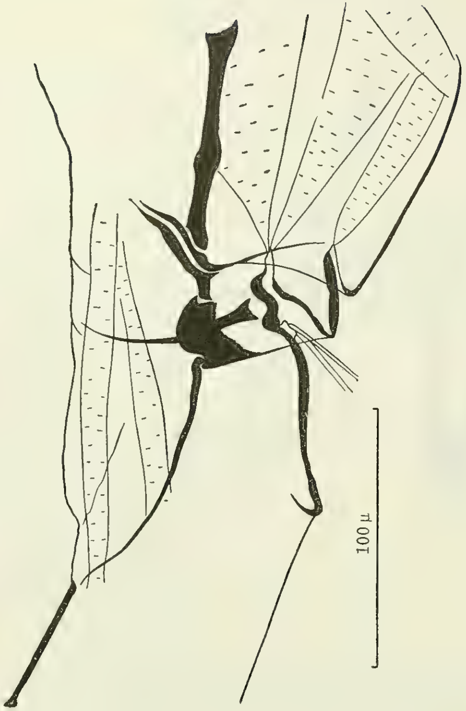

FIGURE 18. Articulation of extended postabdomen of female of *Acroperus elongatus* (Uglich Reservoir, 23 July 1962)

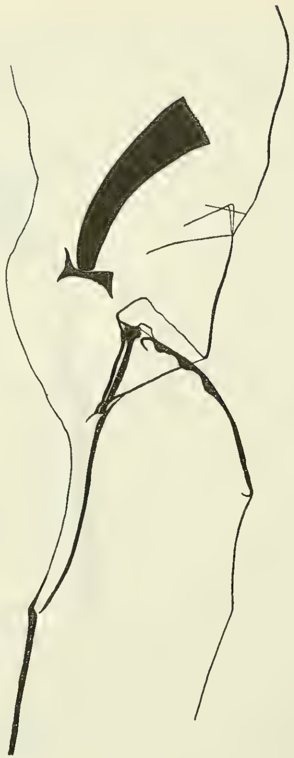

FIGURE 19. Articulation of postabdomen of female of *Camptocercus fennicus* (Pechora River near Lemtybozha, 12 August 1963, preparation 96). Length of apodeme 56 μ.

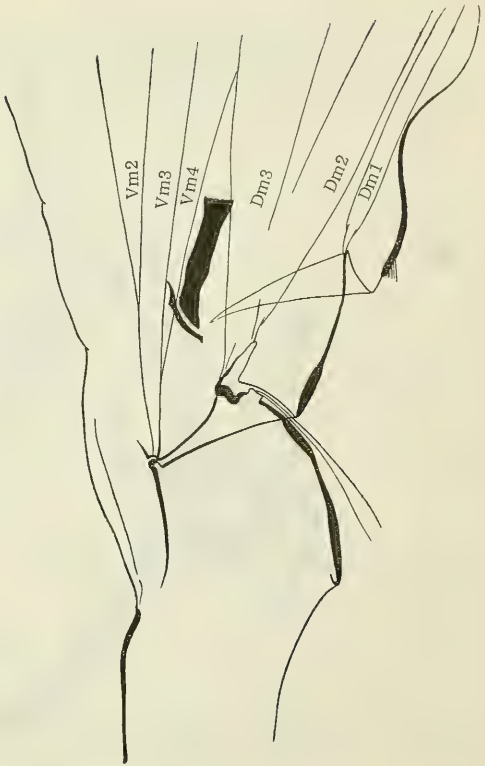

FIGURE 20. Articulation of postabdomen of female of *Camptocercus lilljeborgi* (Il'd River, 10 August 1962). Length of apodeme 48 μ. The fulcrum is below the apodeme. Dorsal and ventral muscles shown.

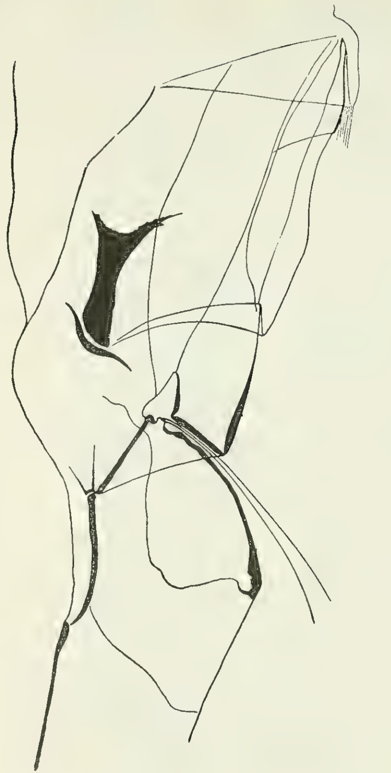

FIGURE 21. Articulation of postabdomen of male of Camptocercus lilljeborgi (Cherepovets Reservoir, 16 September 1963). Length of apodeme 37μ.

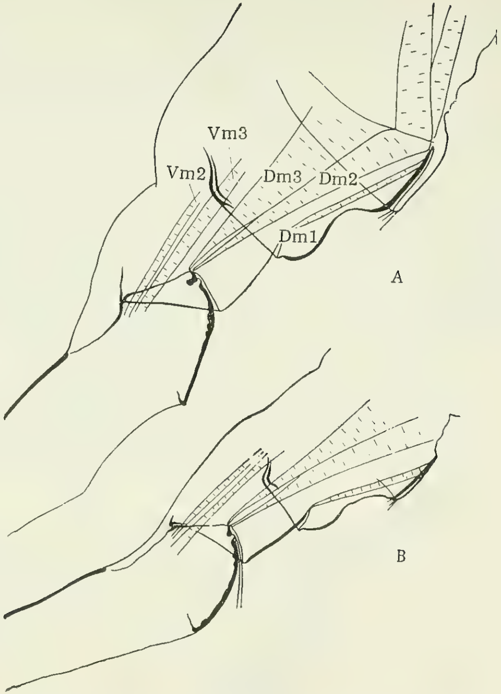

FIGURE 22. Supporting elements and muscles of posterior part of abdomen of Camptocercus rectirostris:

A – female (Rybinsk Reservoir, Borok, 13 September 1961, preparation 562); B – male (Cherepovets Reservoir, Kolenets-Levinskoe, 6 September 1964, preparation 57).

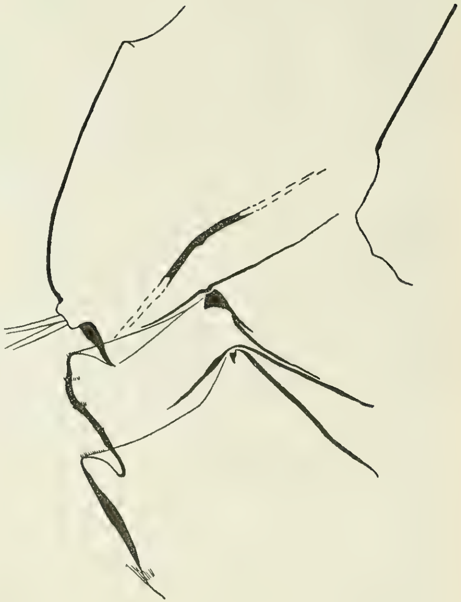

FIGURE 23. Articulation of postabdomen of female of Monospilus dispar (Uglich Reservoir, 23 July 1963). Length of apodeme 46μ.

The articulation of the postabdomen of *Eurycercus* is not chitinized and the postabdomen rotates around its middle, where it is attached by ligaments on both sides. In other Chydoridae, the postabdomen is connected to the abdomen by a chitinized articulation which consists of more or less chitinized structures of the lateral walls.

The body bears 5 or 6 pairs of legs. There are marked differences in form and function, but there is a general pattern in the structure of the legs. Each leg consists of a base (stipes) which bears an endite (ramus interior) and an exopodite (ramus exterior). The gnathobase, or coxal process (processus maxillaris), lies between the stipes and the endite. The endite bears an epipodite (gill) which is situated posterior and lateral to the exopodite. On legs IV and V there is a ciliated lobe, the preepipodite, above the epipodite. Little was known about the legs of the Chydoridae. Sars (1900:13) wrote that the legs are one of the most difficult parts of the anatomy of Cladocera to examine, and that they have therefore remained largely unknown and do not even appear in illustrations. Earlier workers published data on the morphology of the legs of 17 species of the Chydoridae; most of the descriptions were made by Sars (1886, 1901, 1904a) and Lilljeborg (1900). Fryer (1963b) gave a detailed description of the morphology, arrangement, and function of the legs of the female of *Eurycercus lamellatus*. There is a marked difference in the general pattern of the articulation of the various pairs of legs.

Leg I (Figure 30) is curved at the base at a right angle. The anterior surface of the stem of leg I of most species is covered with setules directed distally and arranged in transverse rows or uniformly distributed. The exopodite bears one long seta and sometimes also another very short one. The endite is divided into an inner and an outer ramus, each of which consists of an anterior and a posterior part. Leg I varies markedly in the different genera. The outer ramus of the endite of the females usually bears 3 hook-shaped setae. The parts of the inner ramus bear feathered setae. Other setae are situated on the posterior side, behind the setae of the posterior part of the inner ramus of the endite. The setae of leg I are shown in Figures 36 and 38. The subfamilies differ in the form of the legs and of the setae. For example, the anterior part of the inner ramus of the endite of leg I of *Eurycercus lamellatus* and *Leydigia leydigi* may be of equal size but the other parts of this leg are (relatively) twice as large in *Leydigia leydigi*.

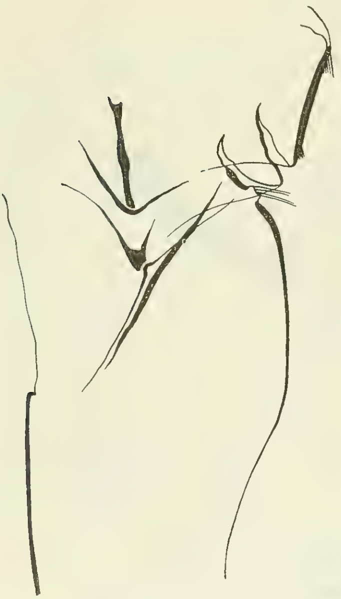

FIGURE 24. Articulation of postabdomen of male of *Monospilus dispar* (Rybinsk Reservoir, Borok, 30 September 1963). Length of apodeme 37 μ.

Leg II (Figure 31) has a wide stem with long, two-segmented spines on the posterior margin. The coxal process is large, directed inward, and bears long setae. The exopodite is situated on the ventral side of the stem;

it is directed dorsolaterally and occupies the space between legs II and III. The morphology of this leg is more or less uniform in all Chydoridae.

Leg III (Figures 32 and 39) has a small endite, a well developed gnathobase, and a large exopodite. All these parts bear setae. Some setae of the exopodite are very large.

Leg IV (Figure 33) has a small endite, a small gnathobase, and a large exopodite. These parts bear setae. All the setae of the exopodite are very large. A preepipodite in the form of a ciliated lobe is situated above the epipodite.

Leg V (Figure 34) consists mainly of a very large exopodite. The endite and gnathobase are little developed. A preepipodite is present above the epipodite. The exopodite bears large setae.

Table 29 gives data on the number of setae on the exopodites of legs III—V. Comparison with primitive Cladocera (Sididae), in which the legs are of uniform structure, shows a general trend toward a reduction in the size of the exopodite of legs I—II accompanied by an enlargement and specialization of the endite; at the same time, there is an enlargement of the exopodite of legs IV—V.

Leg VI, if present, forms a small lobe (Figure 35). This lobe bears an epipodite in Eurycercus.

Some species of Chydoridae show differences in the form and proportions of the legs and their parts. From a functional point of view, there are differences in the proportions of the functional elements. For example, the anterior lobe of the inner ramus of the endite of Leydigia is much smaller than in Eurycercus (Figures 36 and 38).

The legs of the Chydoridae have a complicated chaetotaxy. The description and homologization of the setae of the different species require that each of them be given a designation. The proposed designations of the leg setae are given in Figures 31—48. Arabic numerals are proposed for the numerous setae on the exopodites of legs III—V. The setae of the exopodite of leg III are numbered 1, 2, beginning from the anterior seta, and then from the last seta beginning with the number 8 (Figure 32). The setae of
33 the exopodite of leg IV are given the numbers 1 and 2, beginning from the anterior two setae, then from the last seta (nearest to the epipodite) beginning from 9 and continuing in reverse order (as it is assumed that the reduction of the number of setae takes place at the expense of the smallest setae, which are the intermediate ones after setae 1 and 2; Figure 33). The setae of the exopodite of leg V in the Eurycercinae and Sayciinae are designated as follows: the anterior setae are given the Arabic numerals 1 and 2, then from the last seta beginning from 8 and continuing in reverse order. The anterior seta of the Chydorinae and Aloninae is numbered 3, since there are two long, ciliated processes before this seta in some Chydorinae which may be considered as the reduced setae 1 and 2 (Figures 34 and 48).

The setae of the endites are numbered from 8 backward, beginning from the largest ones (those most distant from the gnathobase, as proposed by Fryer, 1963b). The soft setae of the endites (the row parallel to the row of hard setae) are designated by the letters a — h. The setae of the filtering fan of the gnathobase are designated by numbers, as are the apical setae of the gnathobase (see Figure 40). The setae of leg I which cannot be homologized with setae of the other legs are numbered as shown in Figures 36 and 38.

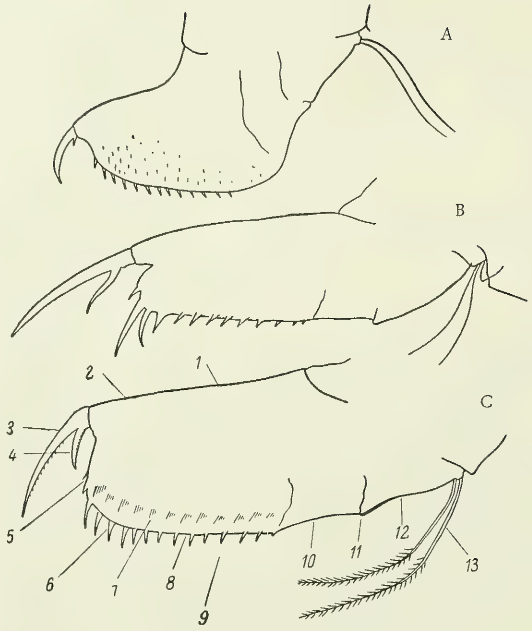

FIGURE 25. Postabdomen of females:

A – Dunhevedia odontoplax (Sars, 1901); B – Oxyurella tenuicaudis; C – Biapertura affinis. 1 – ventral side; 2 – groove; 3 – claw; 4 – basal tooth of claw; 5 – distal side; 6 – anal tooth; 7 – lateral setae; 8 – postanal margin; 9 – dorsal side; 10 – anal margin (margin of anus); 11 – preanal corner; 12 – preanal margin; 13 – natatorial setae.

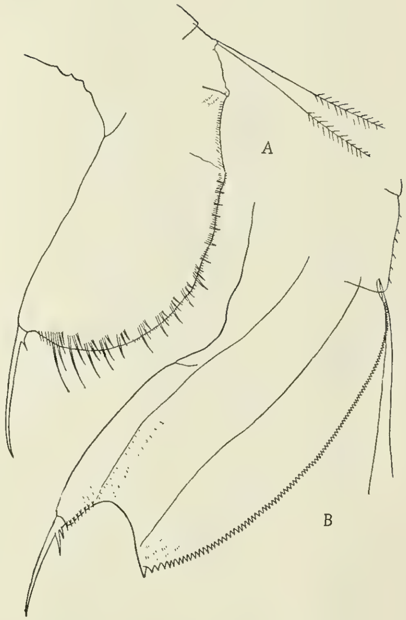

FIGURE 26. Postabdomen of females:

A – Leydigia leydigi; B – Eurycercus lamellatus.

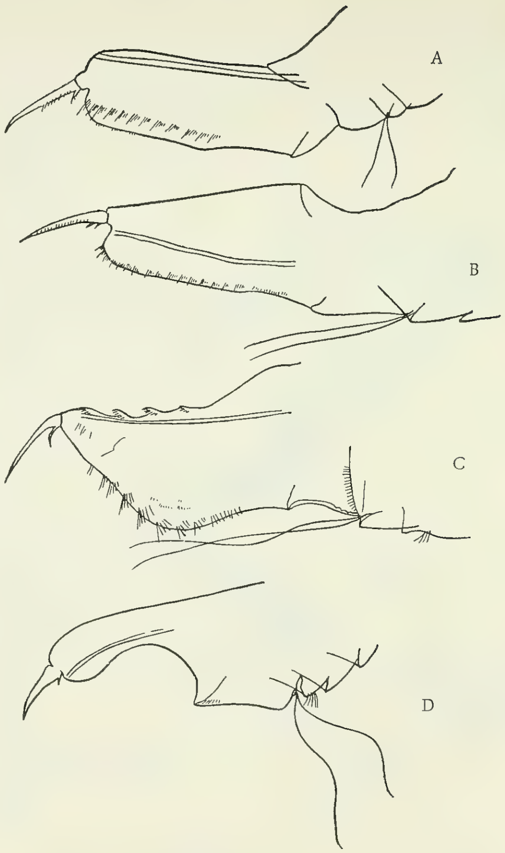

FIGURE 27. Postabdomen of males:

A — *Acroperus alonoides*; B — *Pleuroxus truncatus*; C — *P. uncinatus*; D — *Chydorus sphaericus*.

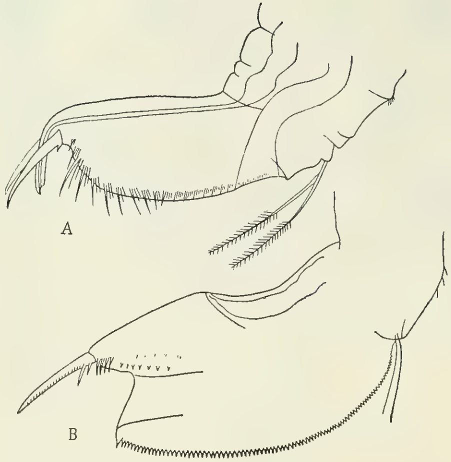

FIGURE 28. Postabdomen of males:

A — *Leydigia leydigi* with penial appendage (after Lilljeborg, 1900); B — *Eurycercus lamellatus*.

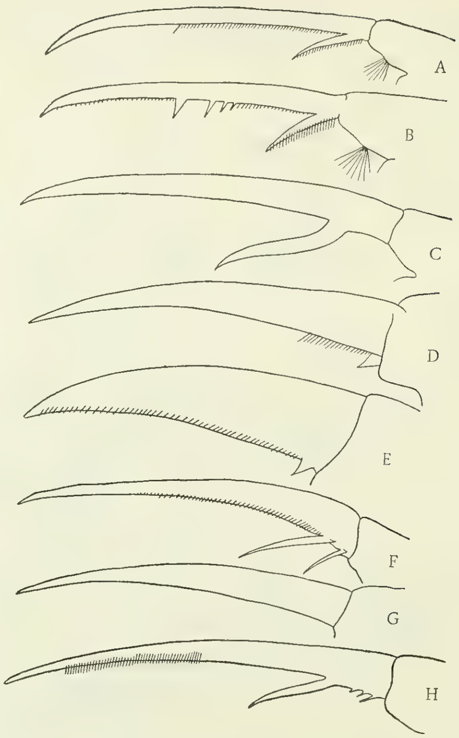

FIGURE 29. Claw:

A — Acroperus harpae; B — A. elongatus; C — Oxyurella tenuicaudis; D — Leydigiopsis brevirostris (after Brehm, 1938a); E — Graptoleberis testudinaria; F — Pleuroxus trigonellus; G — Leydigia acanthocercoides (after Lilljeborg, 1900); H — Oxyurella singalensis (after Green, 1952).

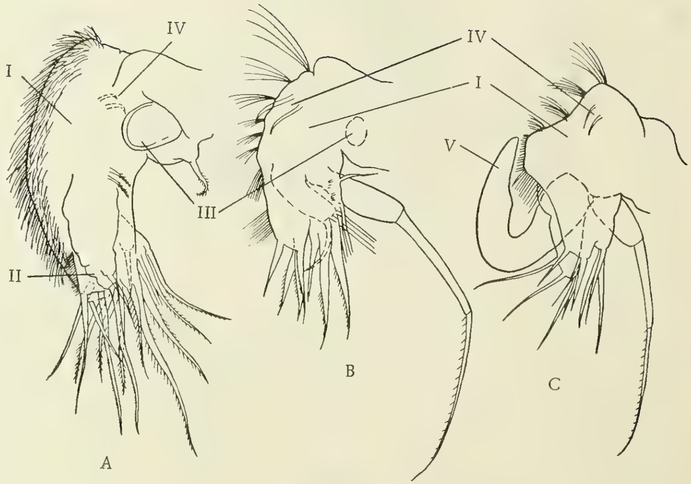

FIGURE 30. Leg I:

A – Saycia cooki, female (Geffard West, Victoria, Australia, 22 August 1961); B – Leydigia leydigi, female (Ladka River, 14 August 1962); C – L. leydigi, male (Ladka River, 14 August 1962). I – endite; II – exopodite with setae; III – epipodite; IV – reversible hooks; V – hook; VI – gnathobase; VII – preepipodite.

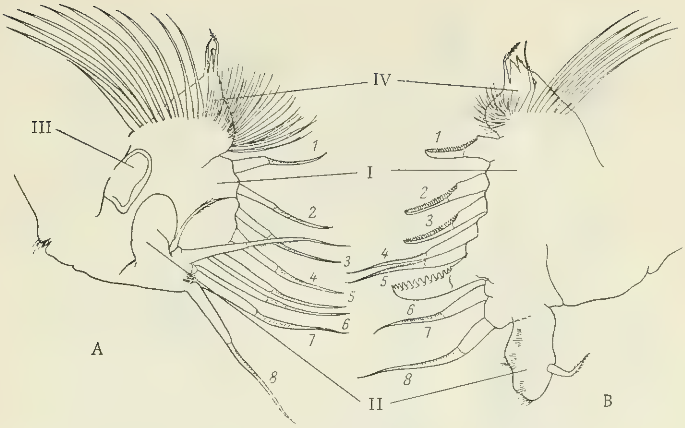

FIGURE 31. Leg II:

A – Saycia cooki, left leg, outer view; B – Camptocercus rectirostris, right leg, outer view (Rybinsk Reservoir, Borok, 13 September 1961). The Arabic numerals indicate the setae of the endite. Other designations as in Figure 30.

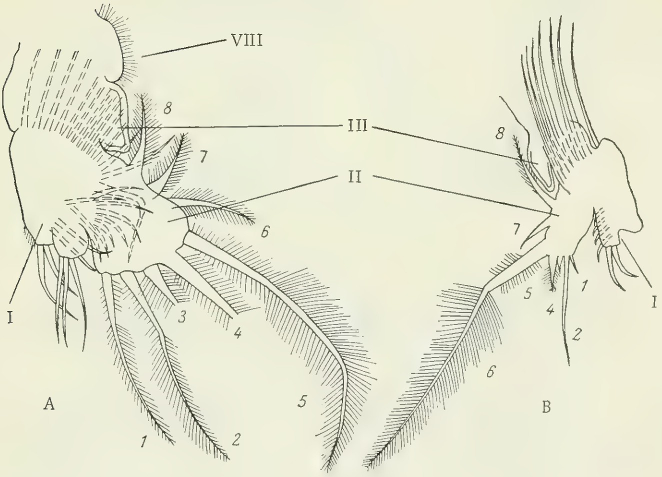

FIGURE 32. Leg III:

A – Saycia cooki, left leg, outer view; B – Indialona globulosa, right leg, outer view (upper reaches of the Nile). The Arabic numerals refer to the setae of the exopodite. Other designations as in Figure 30.

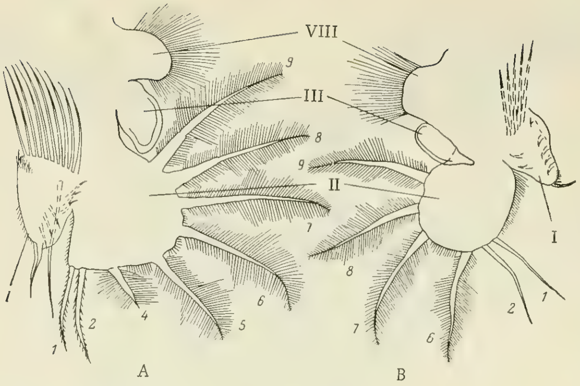

FIGURE 33. Leg IV:

A – *Saycia cooki*, left leg, outer view; B – *Biapertura affinis*, right leg, outer view (Shumorovka River, 2 August 1962). Other designations as in Figures 30 and 32.

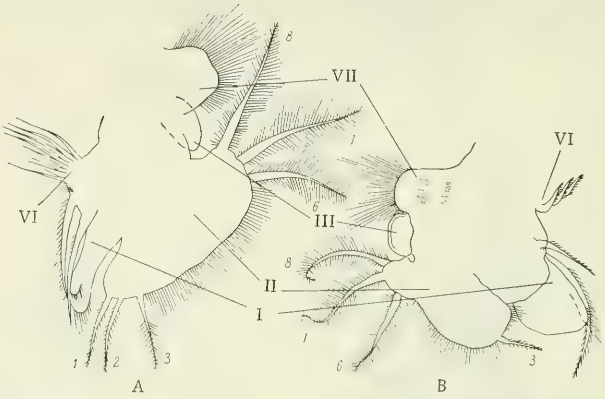

FIGURE 34. Leg V:

A – *Saycia cooki*, left leg, outer view; B – *Biapertura affinis*, right leg, outer view (Shumorovka River, 2 August 1962). Other designations as in Figures 30 and 32.

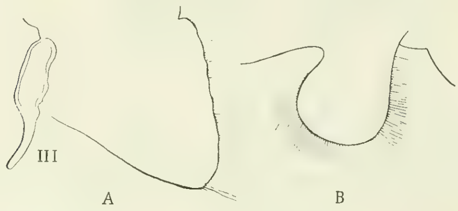

FIGURE 35. Leg VI:

A – *Eurycercus lamellatus*, left leg, inner view; B – *Acroperus elongatus*, left leg, outer view. III – epipodite.

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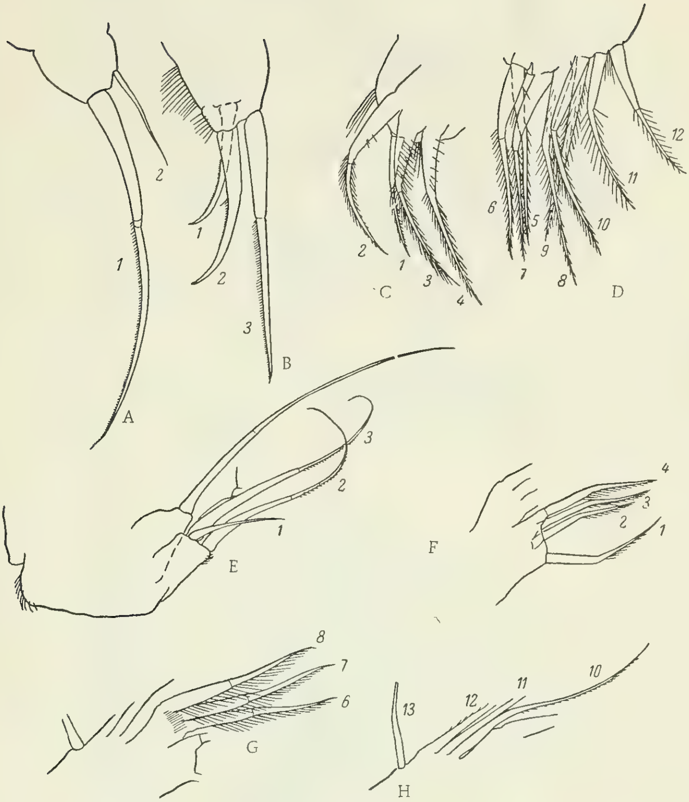

FIGURE 36. Setae of leg I (left leg, outer view) of female of Eurycercus lamellatus (Rybinsk Reservoir, Borok, 9 November 1961):

A – exopodite: 1 – long seta, 2 – short seta; B – outer ramus of endite: 1 – inner hook-shaped seta, 2 — outer hook-shaped seta, 3 — outer brushlike seta; C — anterior lobe of inner ramus of endite: 1 – anterior inner (sensory) seta, 2, 3, 4 – outer feathered setae; D – posterior lobe of inner ramus of endite: 5 – inner seta, 6, 7, 8 – outer setae, 9 – inner seta of posterior margin of endite, 10, 11, 12 – outer setae of posterior margin of endite; E – H – setae of leg I (right leg, inner view) of female of Disparalona rostrata rostrata (Pechora River, 4 August 1963).

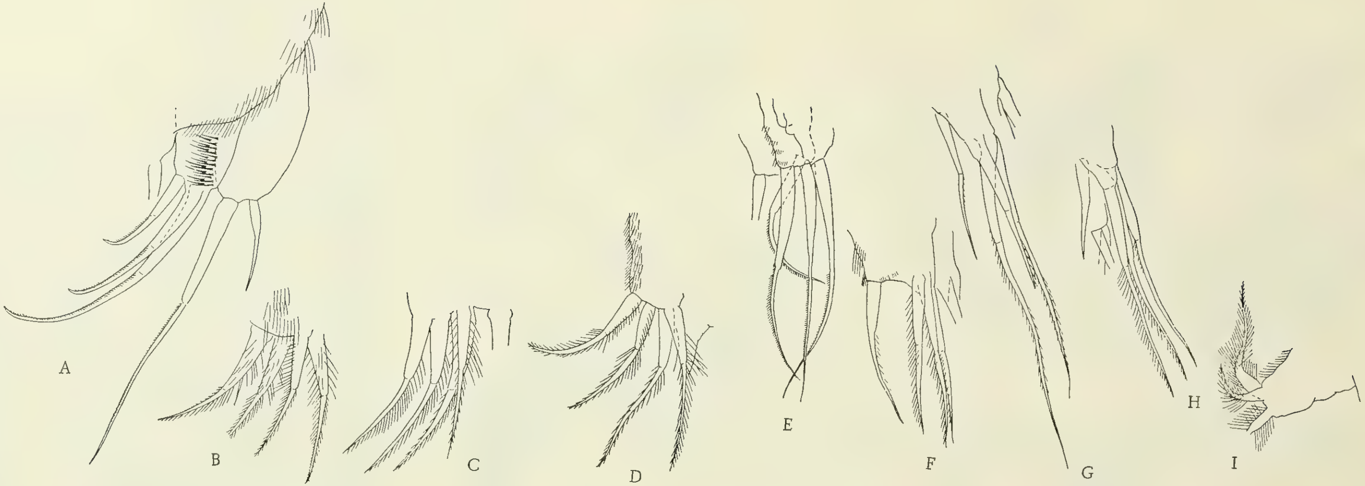

FIGURE 37. Rami of leg I:

A — D,I — *Eurycercus glacialis* (left leg, inner view, Holland, Wadden Island, dune lake, 24 August 1965); E — H — *Saycia cooki* (right leg, outer view, New Zealand, Mangere, May 1965). A,E — exopodite and outer ramus of endite; B,F — anterior lobe of inner ramus of endite; C,G — posterior lobe of inner ramus of endite; D,H — setae on posterior side of endite; I—inner lobe.

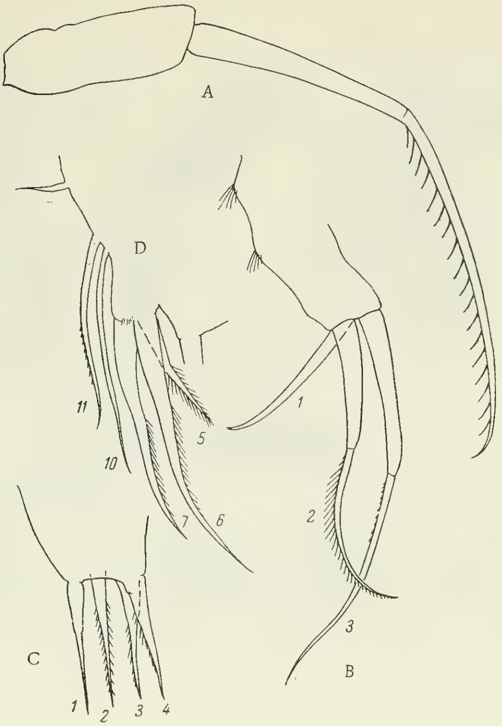

FIGURE 38. Setae of leg I of female of Leydigia leydigi (Ladka River, 14 August 1962):

A – exopodite (left leg, anterior view); B – outer ramus of endite (left leg, outer view): 1 – inner hook-shaped seta, 2,3 – outer setae; C – anterior lobe of inner ramus of endite (right leg, inner view): 1 – anterior inner (sensory) seta, 2, 3, 4 — outer setae; D — posterior lobe of inner ramus of endite (left leg, inner view): 5 – inner seta, 6, 7 – outer setae, 10, 11 – setae on posterior margin of endite.

There are 8 hard setae on the endite of leg III of Eurycercus and Saycia; however, in some of the Chydorinae examined and in Camptocercus rectirostris (Figures 39, 41—44) there are 7 such setae. The row of hard setae on the endite of the Chydorinae consists of two groups which are partly opposite to each other. Such a division of the row of hard setae on the endite of leg III is present to some extent in Saycia cooki and Camptocercus rectirostris. The distal group, directed toward the space between the valves and the substrate, consists of setae 6, 7, and 8; setae 7 and 8 are long, hook-shaped and strongly chitinized in all species while seta 6 is softer and smaller. The specialization of setae 7
36 and 8 as shown in Figure 44 is of particular interest. Seta 6 is very small in Pleuroxus truncatus, P. aduncus, and Chydorus sphaericus. The fan of feathered setae which accompany the hard setae of the endite consists of 8 setae in Eurycercus, 6 setae in Pleuroxus, 4 in Camptocercus rectirostris, and 3 in the specialized species Pseudochydorus globosus.

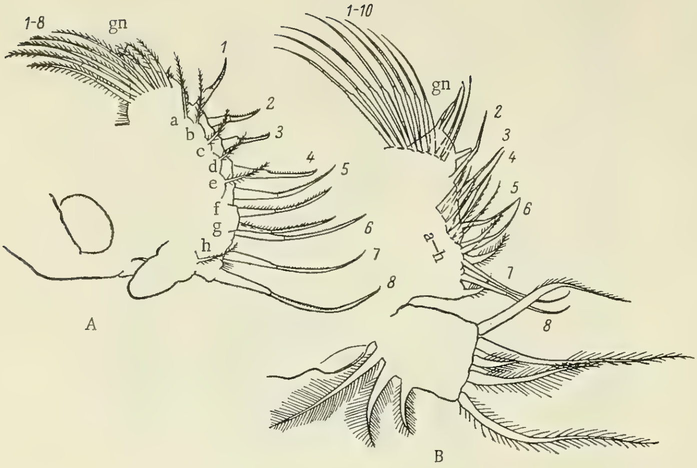

FIGURE 39. Eurycercus glacialis, female (Holland, 24 August 1965):

A – leg II; B – leg III (different scale). 1 – 8 – setae of endite. a – h – setae on outer side of endite. 1 – 10 – setae of gnathobase. gn – setae on apex of gnathobase.

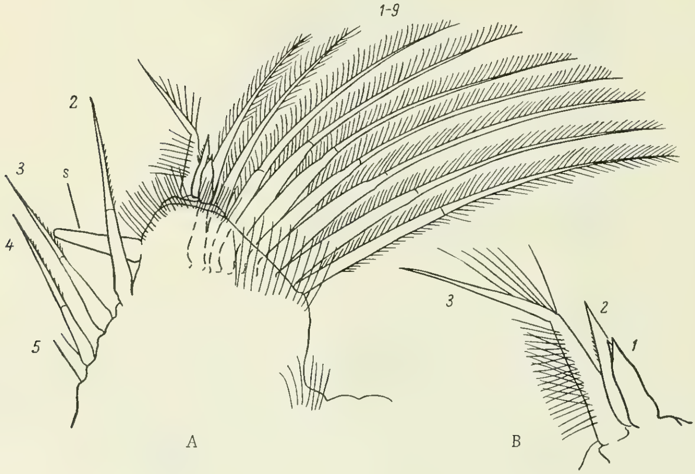

FIGURE 40. Gnathobase of left leg III of Eurycercus lamellatus, female (inner view, Rybinsk Reservoir, Borok, 9 November 1961):

A – general view of gnathobase; B – apical setae of gnathobase; s – sensilla.

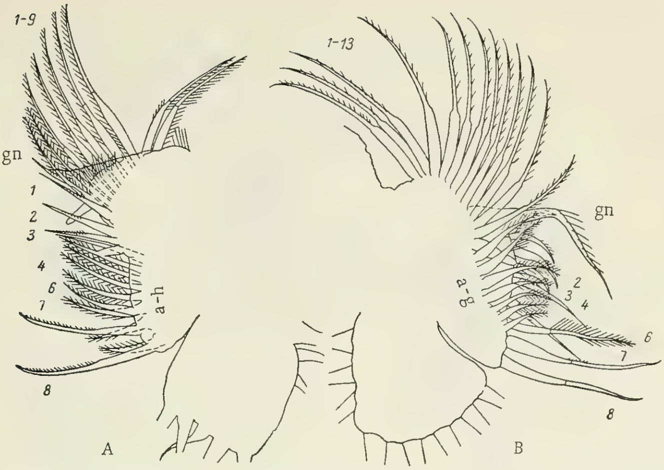

FIGURE 41. Endite and gnathobase of leg III of female:

A – Eurycercus lamellatus (Rybinsk Reservoir, Borok, 9 November 1961); B — Saycia cooki (Geffard West, Victoria, Australia, 22 August 1961). Other designations as in Figure 39 (different scale).

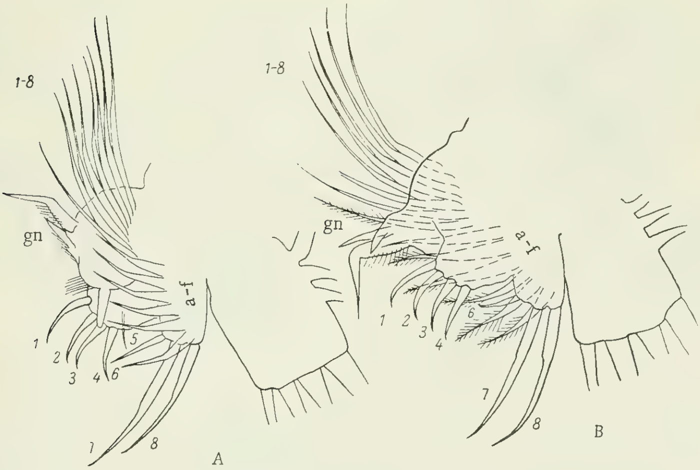

FIGURE 42. Endite and gnathobase of leg III of female:

A – Pleuroxus truncatus (right leg, Rybinsk Reservoir, Borok, 18 September 1962); B — P. aduncus (left leg, Il'd River, 10 August 1962). Other designations as in Figure 39.

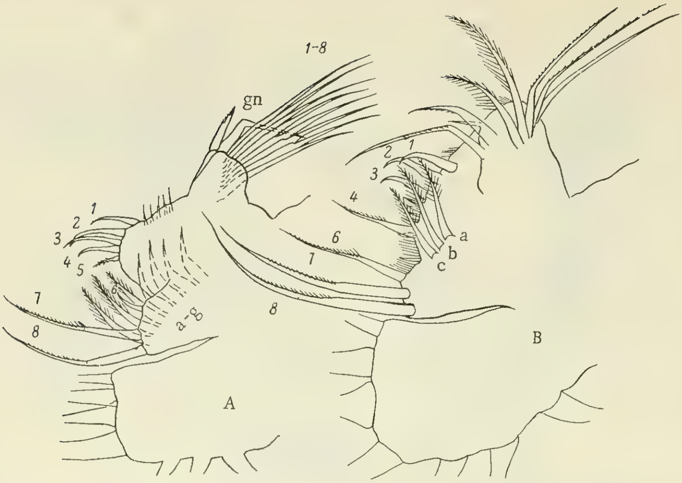

FIGURE 43. Endite and gnathobase of leg III:

A—Chydorus sphaericus (left leg, Rybinsk Reservoir, 13 June 1961); B — Pseudochydorus globosus (right leg, Cherepovets Reservoir, 20 October 1963). Other designations as in Figure 39.

It is difficult to homologize the setae of leg I with those of the other legs. Fryer (1963b: 353) suggested, but did not prove, that leg I of the Chydoridae represents the maxilla. Later study of the other legs, i.e., II and III, III and IV, IV and V, showed the homology of their setae. Figure 39 shows legs II and III of Eurycercus glacialis; the resemblance of the endites and gnathobases is obvious, and homologous setae can be determined. The gnathobase of the closely related species E. lamellatus (Figure 40) bears a fan of 9 filtering setae, compared with 10 in E. glacialis. It is interesting that the number of these setae on leg III of Saycia cooki is 13, in Pleuroxus, Dunhevedia, and Chydorus sphaericus it is 8, while in Pseudochydorus globosus and Camptocercus rectirostris it is 7 (Figures 41—44).

The exopodite of leg IV predominates markedly in size, but the endite and gnathobase resemble those of leg II and especially of leg III. The filtering fan on the gnathobase consists of 11 setae in Eurycercus glacialis, 9 in E. lamellatus, 13 in Saycia cooki, and only 5 in Pleuroxus truncatus, Pseudochydorus globosus, and Dunhevedia serrata. Seta 1 on the apex of the gnathobase is large; it is parallel to the hard setae of the endite in Eurycercus, but in Saycia cooki, Dunhevedi serrata, Pleuroxus truncatus, and Pseudochydorus globosu it is turned back at the base (not at the point where it is divided and where it is bent in leg III) and is directed toward the apex of the hard seta 8 of the endite. The endite of leg IV only has 4 hard setae, and only 3 in P. globosus (in which the penultimate seta is very small). As on leg III, the row of hard setae on the endite of leg IV ends on the gnathobase side in a sensilla (this could not be found in P. globosus or Dunhevedia serrata)

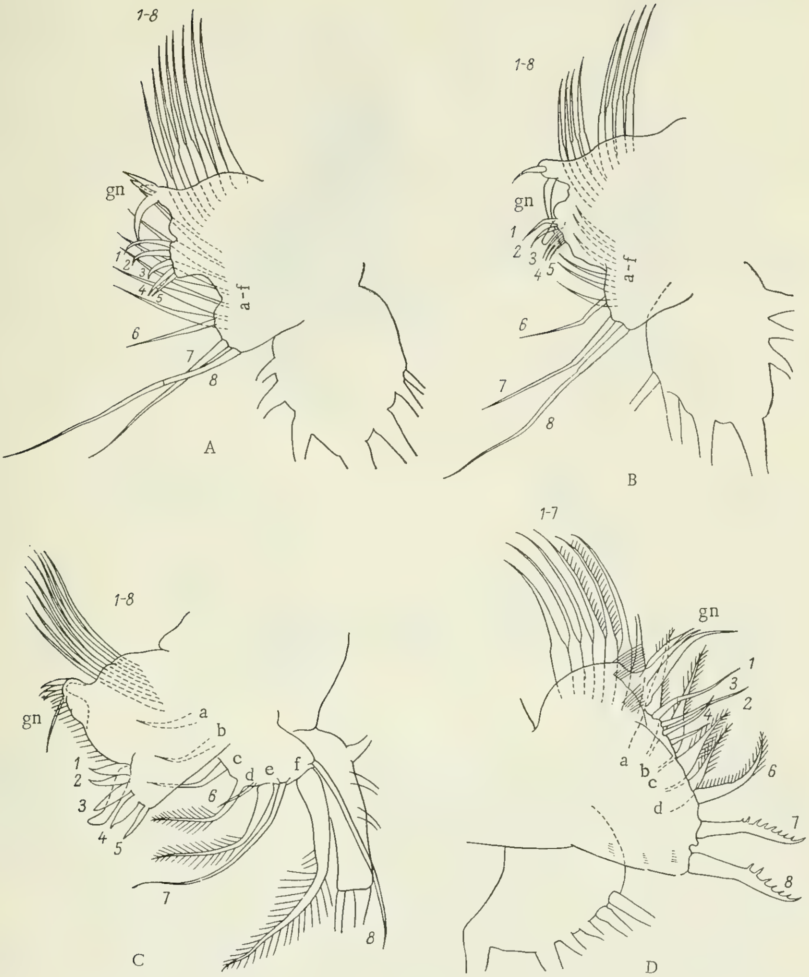

FIGURE 44. Endite and gnathobase of leg III:

A – Dunhevedia serrata (left leg, White Nile, Sobat, 26 December 1963);
B – D. crassa (left leg, Dawson Creek. Queensland, Australia, 18 July 1965);
C – Disparalona rostrata rostrata (left leg, Pechora River, 4 August 1963);
D – Camptocercus rectirostris (right leg, Ivan'kovo Reservoir, 22 July 1962). Note the specialization of setae 7 and 8 of the endite. Other designations as in Figure 39.

(Figures 45–47). The fan of these setae is united with the fan of the setae of the gnathobase in Pleuroxus truncatus, but in all other species examined these fans are distinctly separated. The setae of the soft fan of the endite of Pseudochydorus globosus are small and differ markedly from the setae of the gnathobase.

(38)

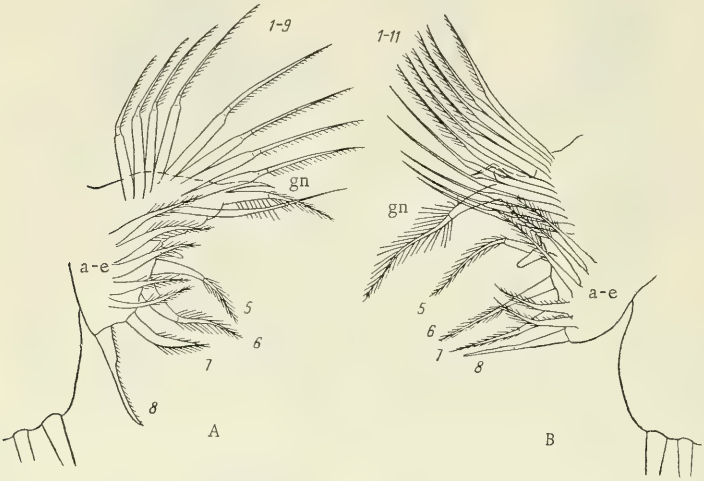

FIGURE 45. Endite and gnathobase of leg IV:

A – Eurycercus lamellatus (Rybinsk Reservoir, 9 November 1961);
B — E. glacialis (Holland, 24 August 1965). Other designations as in Figure 39.

The endite and gnathobase of leg V are little developed, being suppressed by the large endopodite. Homologous setae can be found by comparison with leg IV, since any resemblance of the endite and gnathobase to those of legs II or III has been almost completely lost. The part corresponding to the gnathobase retains a fan of 10 filtering setae in Eurycercus glacialis (Figure 48) (oligomerization compared with leg IV of the same species,
38 which bears 11 such setae); there are only 3 such setae in Pleuroxus truncatus. The endite has only 2 setae, possibly the distal ones, since the lobe adjacent to them may be considered as the prolonged distal corner of the endite. In our comparison of the exopodites, we attempted to find homologies between the setae. We came to the conclusion that the gap between the anterior and posterior setae on the exopodite of leg V developed by the disappearance of the middle setae. The further reduction of the number of setae from 6 to 4 was caused by the loss of the two anterior setae, to judge from the presence of two ciliated processes before the anterior seta. The reduction of the number of setae on the exopodite of leg IV was also caused by the loss of the smallest (middle) setae. During evolution, the reduction of the number of setae was caused by the suppressing effect of the setae of the exopodites of the preceding legs. Eurycercus

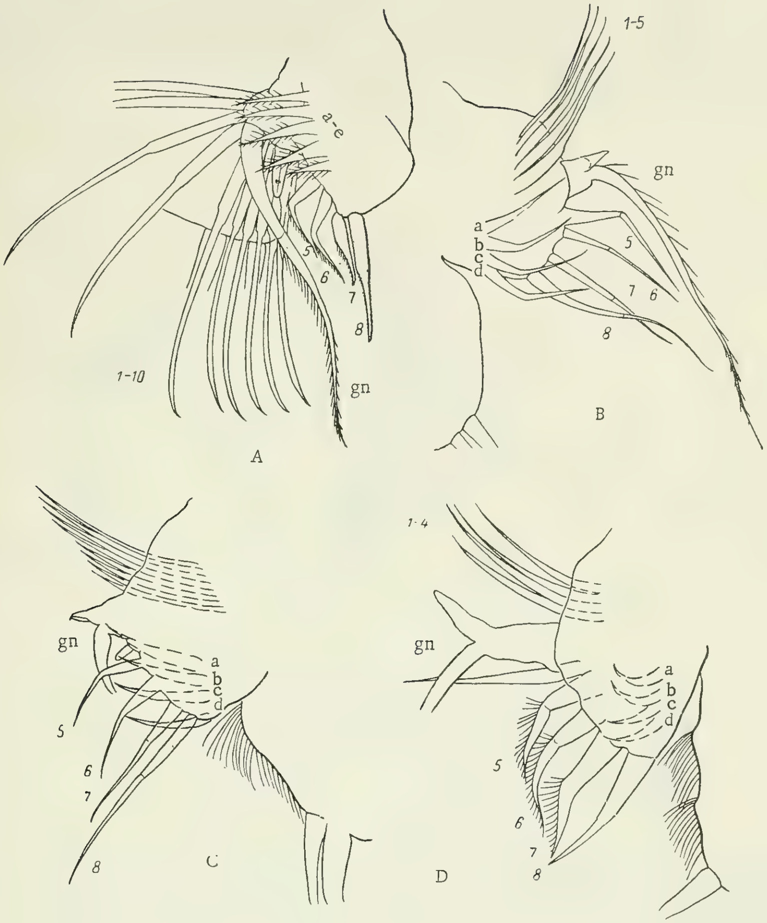

FIGURE 46. Endite and gnathobase of leg IV:

A – Saycia cooki (Geffard West, Victoria, Australia, 22 August 1961);
B — Dunhevedia serrata (White Nile, Sobat, 26 December 1963);
C – D. crassa (Dawson Creek, Queensland, Australia, 18 July 1965);
D – Disparalona rostrata rostrata (Pechora River, 4 August 1963).
Other designations as in Figure 39.

glacialis has a sensilla proximal to these two setae. This sensilla is followed by the seta of the gnathobase, which in this case closely resembles the two setae of the endite. Fryer (1963b) treats these three setae of E. lamellatus together, without distinguishing between them. The endite of Pleuroxus truncatus bears two setae; there is no sensilla or setae on the gnathobase. The hard setae of the endite are not accompanied by other setae on leg V. Figures 49 and 50 show the exopodites of legs IV and V with different numbers of setae:

(40)

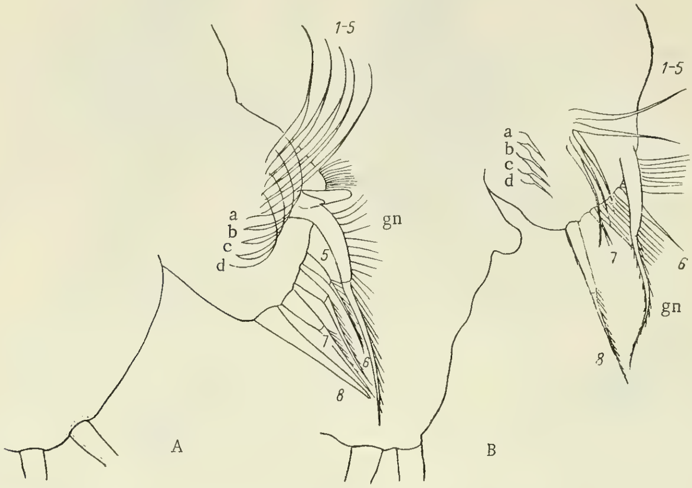

FIGURE 47. Endite and gnathobase of (left) leg IV:

A – Pleuroxus truncatus (Rybinsk Reservoir, 18 September 1962);
B – Pseudochydorus globosus (Cherepovets Reservoir, 20 October 1963).
Other designations as in Figure 39.

In addition to the great diversity of minor (quantitative) differences in the morphology of the legs, some species show a marked specialization. In Biapertura affinis, for example, one of the setae of leg III is very long and reaches to the ends of the setae of the exopodite of leg V. The differences observed in each species are associated with its taxonomic position and the form of the body. The differences in the number of setae on the exopodites of the legs provide one of the characters for the division of the Chydoridae into subfamilies. Legs I of the male bear a hook. The other legs of the male are not distinguishable from those of the female. Our data on the morphology of the legs contribute markedly to a definition of the species and assist in establishing the genera.

The family Macrothricidae is most closely related to the Chydoridae in the morphology of the legs (according to Lilljeborg, 1900, Doolittle, 1911, and our data on Macrothrix laticornis). The Macrothricidae are more primitive in the morphology of the legs (mainly because of the greater number of setae on the legs). Especially closely related to the Chydoridae is the group of genera consisting of Acantholeberis, Ophryoxus, and Parophryoxus, and to a lesser extent, Ilyocryptus. The genera Macrothrix, Drepanothrix, Lathonura, and Streblocerus are much less specialized.

The legs, postabdomen, and thorax of the Chydoridae bear setae whose form and size vary according to their specialization (Figures 51—53). The large setae may be feathered, unilaterally feathered, inversely
40 feathered, sparsely ciliated, or chitinized. The small setae on the body and stem of the legs as well as those forming the feathering are called setules. The ventral side of the thorax of Eurycercus lamellatus (Fryer, 1963b) and E. glacialis bears setae whose ends are directed toward the mouth.

The Chydoridae are usually yellowish brown. The ephippia are dark. The valves of Pseudochydorus globosus are marked with brownish spots of variable size and form (Figure 352). The postabdomen is blackish in some species of Pleuroxus, black in P. striatus. Dadaya macrops is dark and becomes even darker on the ventral side, i.e., the side facing the surface of the water when the animal is feeding (Fryer, 1956). The integument is shining and transparent in Eurycercus, Pleuroxus, Acroperus, Alona, and Camptocercus. The newly molted Camptocercus rectirostris and Pseudochydorus globosus are colorless; this applies in particular to the latter species, the molting female of which is yellow with a brown spot on each valve. Chydorus gibbus is whitish, with a mat, slightly shining and translucent integument. According to Weismann (1878), the female of Eurycercus lamellatus bears two blue spots, one behind the other, on the dorsal side of the thorax before the natatorial setae; such spots are absent in the males. In addition to these spots, our examination of a female of E. lamellatus (Rybinsk Reservoir, 22 May 1964) under incident light showed a blue stripe lateral to the base of the natatorial setae and blue spots on the postabdomen. E. lamellatus is also blue at the base of the mandibles and on the loops of the intestine; the sheath of the esophagus is also blue (Bening, 1941). A reduction in oxygen increases the concentration of hemoglobin; this causes the reddish coloration of some species, particularly Alona quadrangularis, which usually burrows in the surface layer of the silt. According to Bening (1941), reddish specimens of Eurycercus lamellatus also occur. The eggs of Acroperus harpae and Chydorus sphaericus are usually green, but they may also be brown; both types produce a viable progeny.

INTERNAL MORPHOLOGY

Muscular system. A muscular cord situated along the body below the intestine divides in the caudal part into several bundles which move the postabdomen. The muscle of the labrum, the eye muscles, the large muscles of the antennae and, parallel to them, the strong muscles of the mandibles are clearly visible in the anterior part of the body, especially
41 in laterally compressed species (Figures 54—56). The muscles of the antennae and mandibles originate on the dorsal part of the integument. The intestine contains annular and dilator muscles; the latter originate on the wall of the labrum or of the postabdomen.

The musculature of the mandibles of Eurycercus lamellatus was described by Fryer (1963b). The muscles are asymmetrical, like the mouth parts. They are striated. As shown by Tollinger (1909), the labrum of Biapertura intermedia contains the dilators of the esophagus and partly the annular muscles of the esophagus. Annular muscles are also present in the mid-intestine.

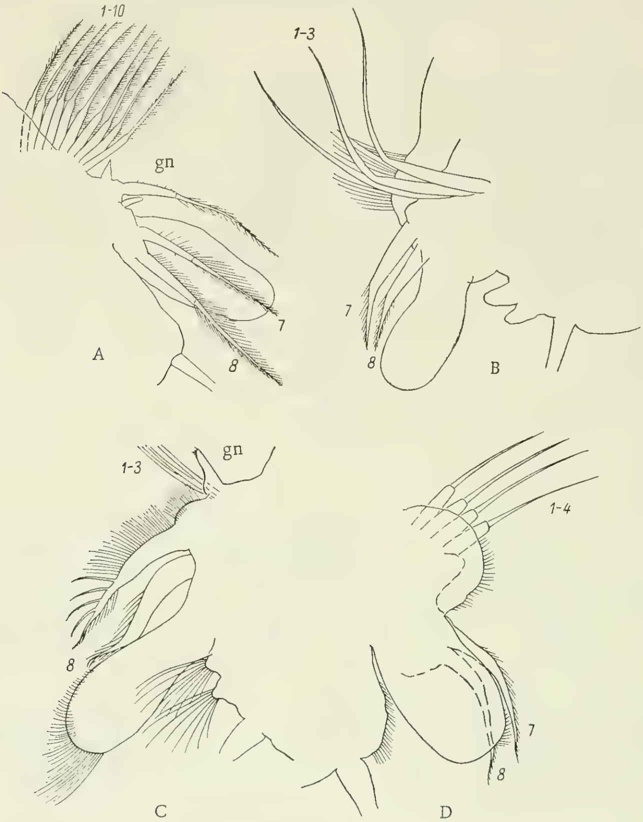

FIGURE 48. Endite and gnathobase of leg V:

A – Eurycercus glacialis (Holland, 24 August 1965);
B – Pleuroxus truncatus (Rybinsk Reservoir, 18 September 1962);
C – Disparalona rostrata rostrata (Pechora River, 4 August 1963); D – Dunhevedia crassa (Dawson Creek, Queensland, Australia, 18 July 1965). Other designations as in Figure 39.

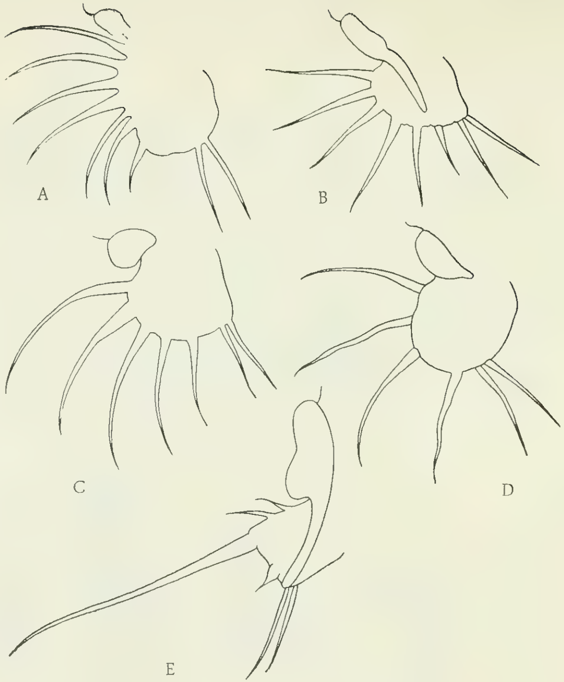

FIGURE 49. Oligomerization of the setae on the exopodite of leg IV. The epipodites are also drawn to show the orientation of the exopodites:

A – Eurycercus glacialis (Netherlands, 24 August,1965); B – E. lamellatus; C – Disparalona rostrata; D – Biapertura affinis; E – Camptocercus rectirostris (B— E — Rybinsk Reservoir).

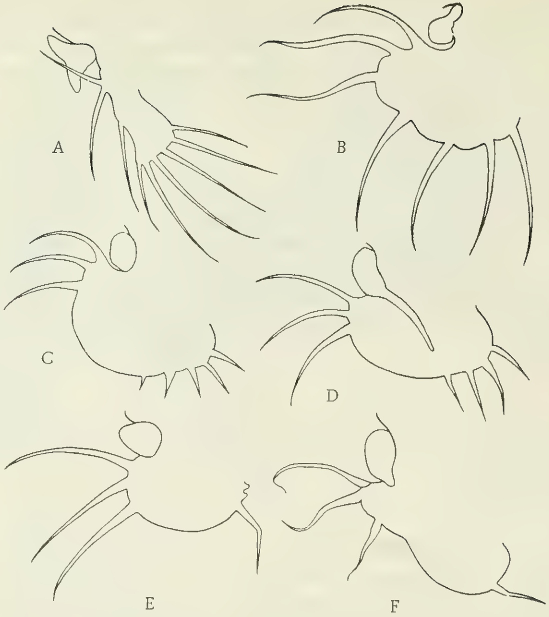

FIGURE 50. Oligomerization of the setae on the exopodite of leg V:

A – Sida crystallina (O.F. Müller) (Sididae, after Bening, 1912); B – Ilyocryptus sordidus (Liévin) (Macrothricidae, after Lilljeborg, 1900); C – Eurycercus glacialis (Netherlands, 24 August,1965); D – E. lamellatus; E – Disparalona rostrata; F – Biapertura affinis (D – F – Rybinsk Reservoir).

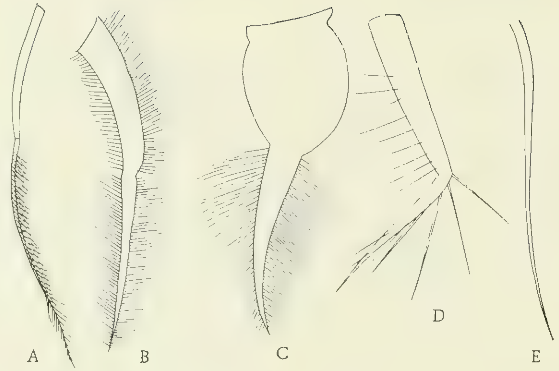

FIGURE 51. Form of setae:

A – two-segmented, bilaterally feathered seta on first segment of antenna of Eurycercus lamellatus (Sunozhka River, 9 August 1962); B – bilaterally reversely feathered seta 8 of exopodite of leg III of Pseudochydorus globosus (Cherepovets Reservoir, mouth of Kovzha River, 20 October 1963); C – leaf-shaped seta 5 of exopodite of leg III of Camptocercus lilljeborgi (Sutka River, 11 August,1962); D – geniculate seta of apex of gnathobase of leg III of male Eurycercus lamellatus (Rybinsk Reservoir, 2 October 1962); E – bare, simple seta of antennule of female of E. lamellatus (Sunozhka River, 9 August 1962).

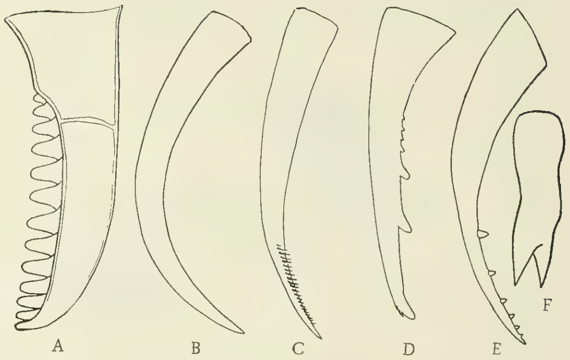

FIGURE 52. Form of setae:

A – denticulate seta 6 of endite of leg II of female of Camptocercus rectirostris (Rybinsk Reservoir, Borok, 13 September,1961); B – bare seta of outer ramus of endite of female of Biapertura affinis (Shumorovka River, 2 August 1962); C – pectinate seta of outer ramus of endite of female of Chydorus sphaericus alexandrovi (Lake Diyaty, Arkhangelsk Region, 18 July 1961); D – denticulate seta of outer ramus of endite of female of Euryalona occidentalis (upper Nile); E – denticulate seta of outer ramus of endite of female of Anchistropus emarginatus (Angara River, Irkutsk Region, 23 August 1952, preparation 1629); F – bifurcate seta 1, apical appendage of gnathobase of leg III of Eurycercus lamellatus (Rybinsk Reservoir, Borok, 9 November 1961).

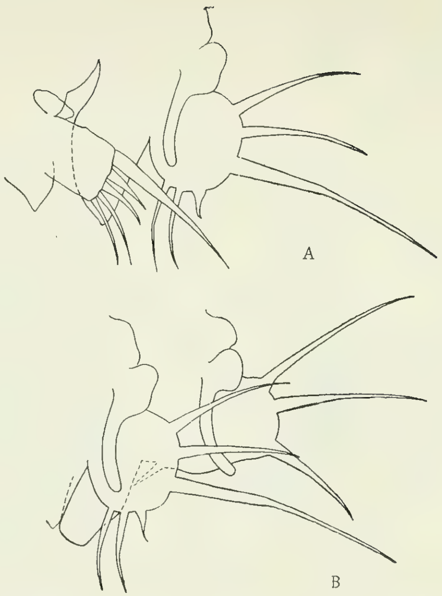

FIGURE 53. Position of legs of Acroperus harpae (drawn from live specimens from the Rybinsk Reservoir; setules not shown):

A — legs III and IV; B—legs IV and V. The figure shows the relationships between the legs and their setae and their position with respect to the ventral margin of the valve. Note the suppression of setae by the large setae, the size of which apparently depends on the angle with the straightened valve margin and the distance to this.

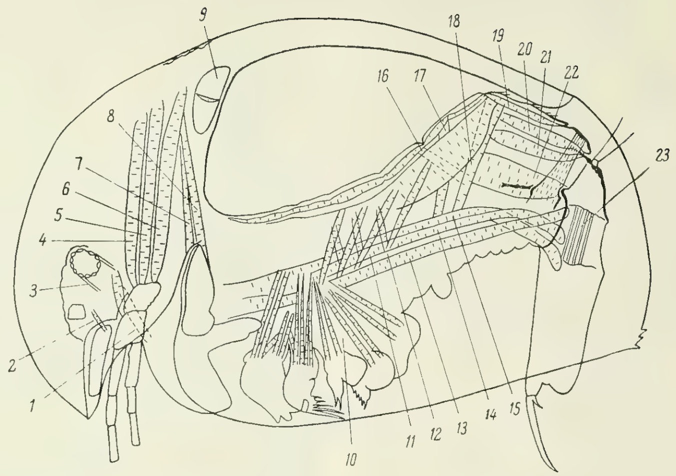

FIGURE 54. Musculature of Acroperus harpae:

1—levator labri; 2—flexor antennulae; 3—eye muscles; 4—abductor[1]; 5—abductor[2]; 6—levator; 7—rotatores anteriores; 8—rotatores posteriores; 9—heart; 10—leg muscles; 11—lateral muscles; 12—dorsoventral muscles; 13—ventral muscle Vm1; 14—Vm2; 15—Vm3; 16—abdominal muscle Ad1; 17—Ad2; 18—Ad3; 19—dorsal muscle Dm1; 20—Dm2; 21—Dm3; 22—Dm4; 23—annular muscles of hind intestine.

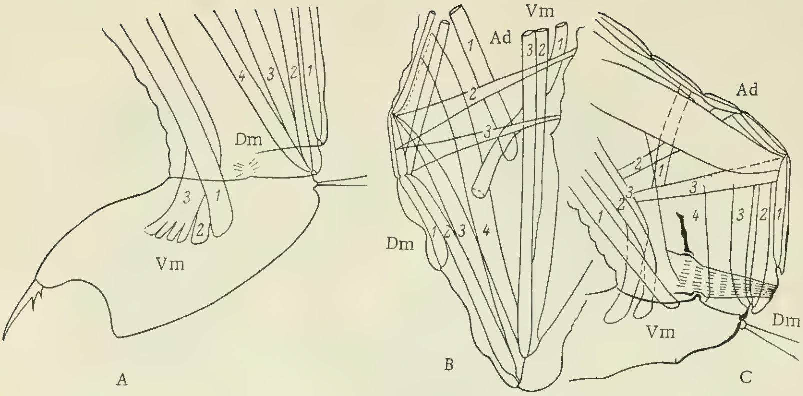

FIGURE 55. Muscles of postabdomen:

A — Eurycercus lamellatus (from a live specimen, Rybinsk Reservoir, Borok); B — Camptocercus lilljeborgi (after Green, 1956); C — Acroperus harpae. Dm— dorsal muscles; Vm — ventral muscles; Ad — abdominal muscles. The Arabic numerals indicate the numbers of the ventral and dorsal muscles.

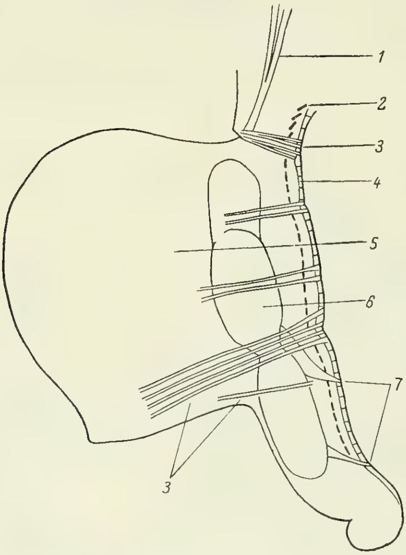

FIGURE 56. Labrum of Biapertura intermedia (after Tollinger, 1909):

1 — levator labri; 2 — annular muscles of esophagus; 3 — dilators of esophagus; 4 — epithelium of esophagus; 5 — plate-shaped process; 6 — reservoir of secretion; 7 — efferent ducts for secretion.

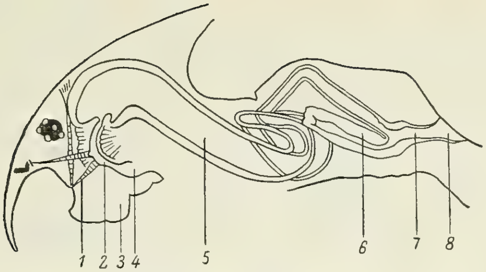

FIGURE 57. Digestive tract of *Biapertura intermedia* (after Tollinger, 1909):

1—dilators of esophagus; 2—esophagus (fore intestine); 3—labrum; 4—mouth; 5—mid-intestine; 6 — process; 7—hind intestine; 8—anus.

For the Cladocera, Binder (1929, 1931) uses the terms adductors for muscles which bring the appendages close to the body, and abductors for muscles which move the appendages away from the body. The muscles of the ventral side can be divided into thoracic and abdominal muscles. Binder designates these muscles Vm1, Vm2, etc., beginning ventrally (the direction of these muscles changes in the posterior part and their position with respect to the ventral margin may therefore vary). Each of the muscles ends before the following one. The abdominal muscles extend from the dorsal to the 46 ventral side in the posterior part of the abdomen. Binder designates them Ad1, Ad2, etc., beginning from the anterior ventral part posteriorly. As shown in Figure 54, the muscles do not penetrate deeply into the postabdomen. The dorsal muscles end at the segmental folds, which are present in the Chydoridae only in the posterior part of the body. The lateral musculature consists of oblique lateral muscles which extend posterodorsally — anteroventrally, and dorsoventral muscles which extend from the dorsal to the ventral side. The legs contain adductors and abductors and muscles which move the different segments of the legs.

According to Green (1956), the dorsal muscle 1 of *Camptocercus lilljeborgi* is inserted high, at the level of the fulcrum (Figure 55). Dorsal muscle 4 is inserted at the border between the postabdomen and abdomen, and dorsal muscles 2 and 3 on the posterior corner of the post- 47 abdomen, which they pull. The site of attachment of the ventral muscles 2 and 3 coincides with that of dorsal muscle 4. These ventral muscles move the postabdomen forward and pull it toward the abdomen. The abdominal muscles 2—3 extend from the dorsal to the ventral side of the abdomen. The abdominal muscle 1 is directed obliquely dorsally; its action is to some extent opposite to that of ventral muscle 1. The endings of the muscles do not penetrate deeply into the postabdomen. There are no muscles inside the postabdomen itself. Dorsal muscle 1 of *Eurycercus lamellatus* is inserted above dorsal muscles 2—4, which are attached to the posterior margin of the postabdomen. The abdominal muscles extend obliquely dorsally and do not continue in the postabdomen (Figure 55). The Chydoridae also have muscles which extend from the body to the valves and close them. The musculature of the Chydoridae is markedly specialized; the groups of muscles which move the postabdomen and the muscles which move the antennae are especially well developed. A well developed group of muscles causes the movements of the legs and their parts.

Intestine. A mobile labrum, usually with a plate-shaped process, and a labium without appendages are situated near the mouth. There are paired salivary glands inside the labrum (Figure 56). The narrow esophagus opens into the wide mid-intestine which ends in the hind intestine (Figure 57). The posterior end of the mid-intestine bears a caecum in most species; the length of the caecum varies in different species. The caecum is situated on the ventral side of the intestine and is directed anteriorly. Only Eurycercus has blind diverticula at the anterior end of the mid-intestine (hepatic processes). The mid-intestine forms loops. Observations of live material
48 showed a long caecum in Pleuroxus striatus, P. aduncus, P. trigonellus, P. truncatus, Alonella excisa, Disparalona rostrata, Chydorus sphaericus, Ch. gibbus, Graptoleberis testudinaria, Acroperus harpae, A. elongatus, and Camptocercus; according to the literature, a similar caecum is present in Biapertura intermedia. The caecum of Eurycercus lamellatus is short, vesiclelike. The fore and the hind intestine are lined with a chitinous cuticle; the mid-intestine has no such lining. The anus is situated on the dorsal side of the postabdomen or at its distal end (Eurycercus).

(46)

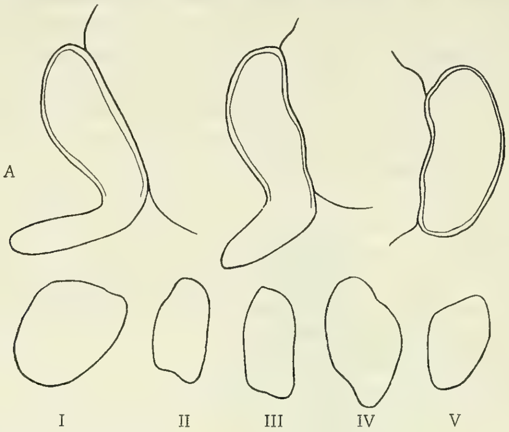

FIGURE 58. Epipodites:

A—different forms of epipodites of leg VI of Eurycercus lamellatus (after Lilljeborg, 1900); B—epipodites of legs I—V of left side of Saycia cooki, outer view (Geffard West, Victoria, Australia, 21 August 1961).

The glands of the labrum (the secretion of these glands glues the food together) have been found in E. lamellatus (Fryer, 1962a, 1962b), Saycia cooki (Sars, 1904a), and Biapertura intermedia (Tollinger, 1909, Figure 56). Fryer (1963b) observed the secretion of this gland and its opening on the inner side of the labrum at the beginning of the esophagus in Eurycercus lamellatus. A gland whose secretion glues the food together is situated at the base of leg IV of E. lamellatus; a reservoir situated on the inside of leg IV opens distal to the basal filtering plate
51 (Fryer, 1962a, 1962b). The branches of the seta on the outer lobes of legs IV and V secrete a sticky substance (Fryer, 1962b). Numerous oil droplets are situated in the body, postabdomen, at the valves, and in the legs (for example, in Graptoleberis testudinaria testudinaria).

(47)

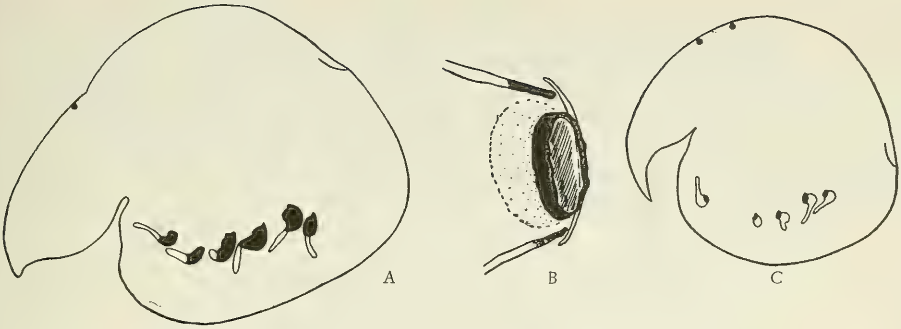

FIGURE 59. Vital staining with silver nitrate (Rybinsk Reservoir):

A — Eurycercus lamellatus, length 2.8 mm (22 May 1964); B — head pores and canals from the small pores; C — Chydorus sphaericus, length 0.53 mm (26 May 1964).

(48)

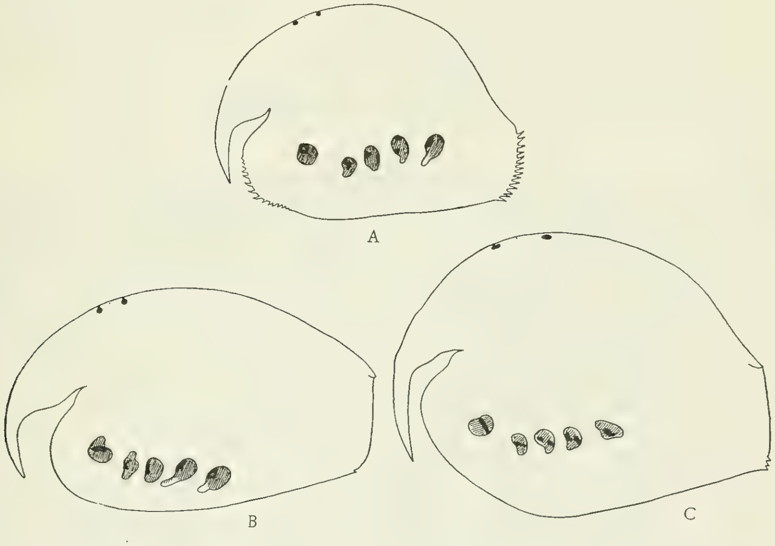

FIGURE 60. Vital staining with silver nitrate (Rybinsk Reservoir, Borok):

A — Pleuroxus truncatus, length 0.6 mm (27 May 1964); B — P. striatus, length 0.67 mm (9 June 1964); C — P. trigonellus, length 0.64 mm.

Respiratory organs (Figures 58–66). The respiratory surfaces can be demonstrated by vital staining with a pink solution of potassium permanganate or with silver nitrate after Dejdar (1930a). We decreased the concentration of $AgNO_3$ to 0.5% to prevent the animals dying before being stained. These substances are highly toxic for the Chydoridae; 100% of Chydorus sphaericus died within 24 hours at a concentration of

0.00001% $AgNO_3$ or 0.003% $KMnO_4$ (at 20°C). The areas in which the hemolymph is oxidized and the surrounding liquid is reduced take up the stain and become sharply distinguished from the adjacent surfaces. This procedure shows the gills, which are situated on the posterior margin of the outer side of the legs. One can also see a small area around the main head pores, and in some Chydoridae canals which penetrate into the tissue
53 from the small lateral pores. Some of our data on the structure of the epipodites are based on material fixed with formalin.

(48)

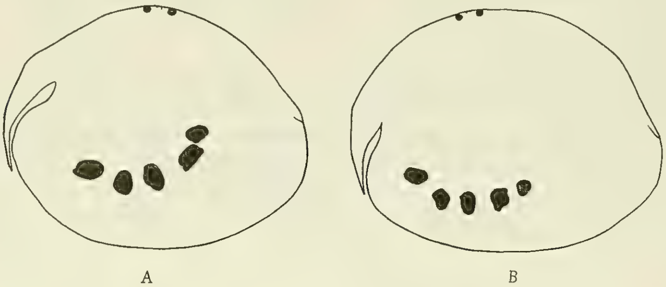

FIGURE 61. Vital staining of Pseudochydorus globosus with silver nitrate (Rybinsk Reservoir, 25 June 1964):

A — male, length 0.6 mm; B — female, length 0.74 mm.

Epipodites are present on all 6 pairs of legs in the subfamily Eurycercinae (Eurycercus lamellatus) (Figures 47 and 48). The staining shows the main head pores and the canals, all of which extend anteroventrally from a small pore. There are 5 pairs of epipodites, according to the number of legs in the subfamily Sayciinae (Saycia cooki). The epipodites are ellipsoidal, without processes. There are 5 pairs of epipodites in the subfamily Chydorinae. In Chydorus ovalis (after Lilljeborg, 1900) and Ch. sphaericus, the epipodites of legs II have no processes but the others do have them. All the epipodites of Pseudochydorus globosus (both sexes) are almost without processes. The epipodite of Pleuroxus laevis are without processes. P. striatus and P. truncatus have small processes on the epipodites of legs IV and V. The epipodites of P. trigonellus and P. uncinatus are almost without processes. The epipodites of legs II and III of Alonella excisa have no processes but the others have them. The epipodites of Disparalona rostrata have no processes. Processes are also absent on the epipodites of Anchistropus emarginatus. In this subfamily (Chydorus, Pleuroxus, and Alonella), a small area near the main head pores becomes stained, but the small pores do not. In the subfamily Aloninae, Alona rectangula and A. costata have no processes on the epipodites of legs II but they do have them on the other epipodites. The epipodites of legs II and III of Graptoleberis have no processes, but the others have them. Processes are present only on the epipodites of legs IV and V of Euryalona occidentalis. In Acroperus harpae, the epipodites

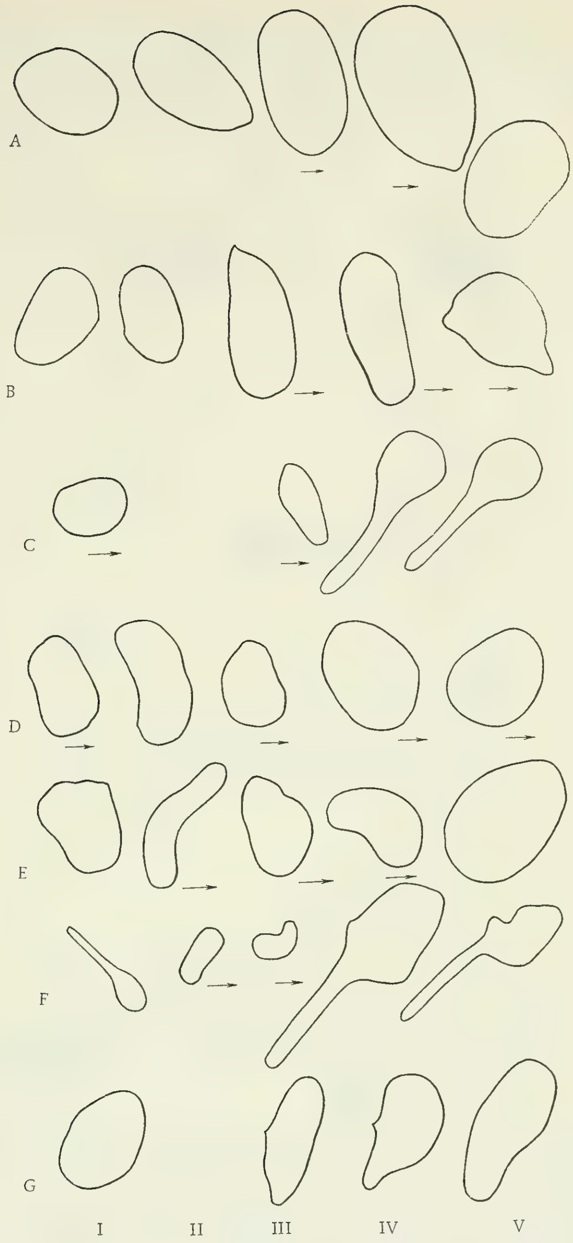

FIGURE 62. Epipodites I—V, viewed from the left. The arrows indicate the direction toward the head:

A — Pleuroxus laevis (Shumorovka River, 2 August 1962); B — P.uncinatus (Il'd River, 10 August 1962); C— Alonella nana (Pechora River near Kuz'dibozh, 16 August 1963); D—Disparalona rostrata (Uglich Reservoir, 23 July 1962); E— Anchistropus emarginatus (after Lilljeborg, 1900); F — Chydorus ovalis (after Lilljeborg, 1900); G — Dunhevedia crassa (puddle at Bug Liman, 23 June 1963).

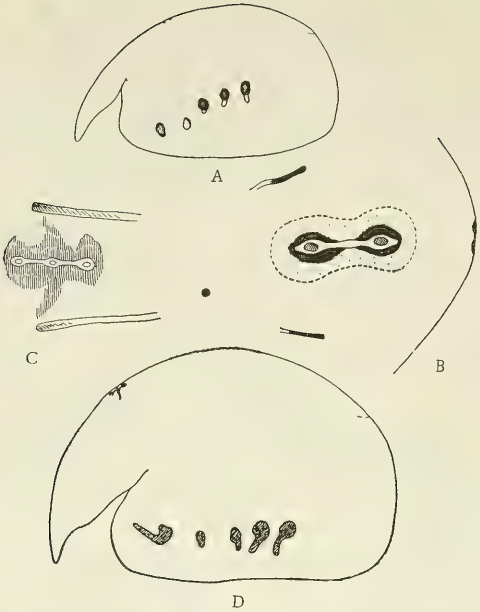

FIGURE 63. Vital staining with silver nitrate (Rybinsk Reservoir, Borok):

A — Biapertura affinis, length 1.0 mm (27 May 1964); B — head pores; C — head pores; D — Alona rectangula, length 0.39 mm (9 June 1964).

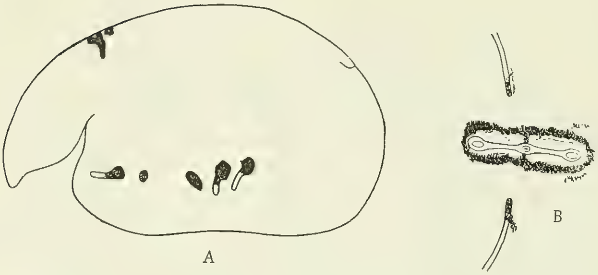

FIGURE 64. Vital staining with silver nitrate (Rybinsk Reservoir, Borok, 10 June 1964):

A — Alona costata; B — head pores.

of legs I, IV, and V have long processes, while in A. elongatus the epipodites of leg I have no processes. The epipodites of Leydigia australis (after Sars, 1886) and L. leydigi are almost without processes. Leydigiopsis curvirostris has no processes on the epipodites (Sars, 1901). In this subfamily (Alona), the staining showed canals which penetrate inward from the small lateral pores.

(51)

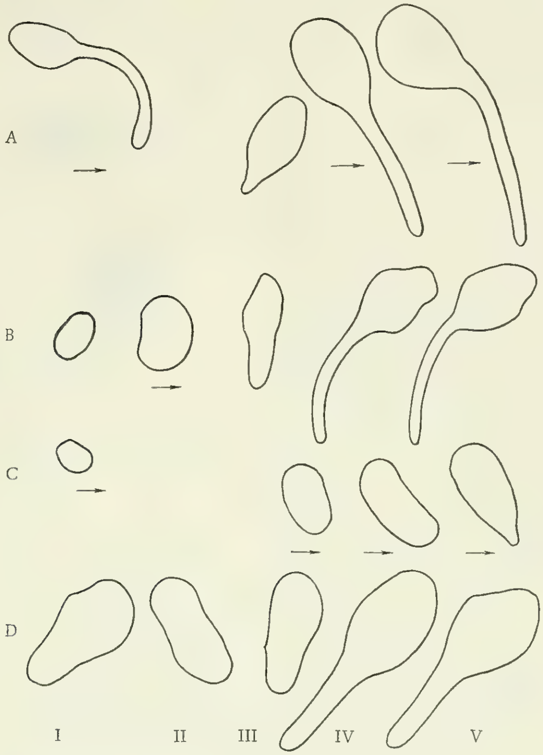

FIGURE 65. Epipodites of legs I—V:

A — Euryalona occidentalis (I, II, IV after Sars, 1901); B — Alona quadrangularis; C — Acroperus elongatus; D — A. alonoides. The arrows show the direction to the head.

The blood which has been oxidized in the areas of the epipodites is moved by the action of the heart. The heart is ellipsoidal and situated dorsally before the brood pouch. Its length is 9—10% of the body length in Alona, Acroperus, Alonella, Camptocercus, Graptoleberis, and Monospilus, and 15—17% in Chydorus sphaericus and Pseudochydorus globosus (Table 10). Blood and formed elements enter the heart through a pair of lateral ostia. The efferent opening is situated anteriorly. Herrick (1884) found membranes in the heart which separate the venous from the arterial blood. The hemolymph is much more concentrated than the surrounding water; the depression (Δ° C) of the hemolymph of Eurycercus glacialis is 0.37, compared with about 0.01

(52)

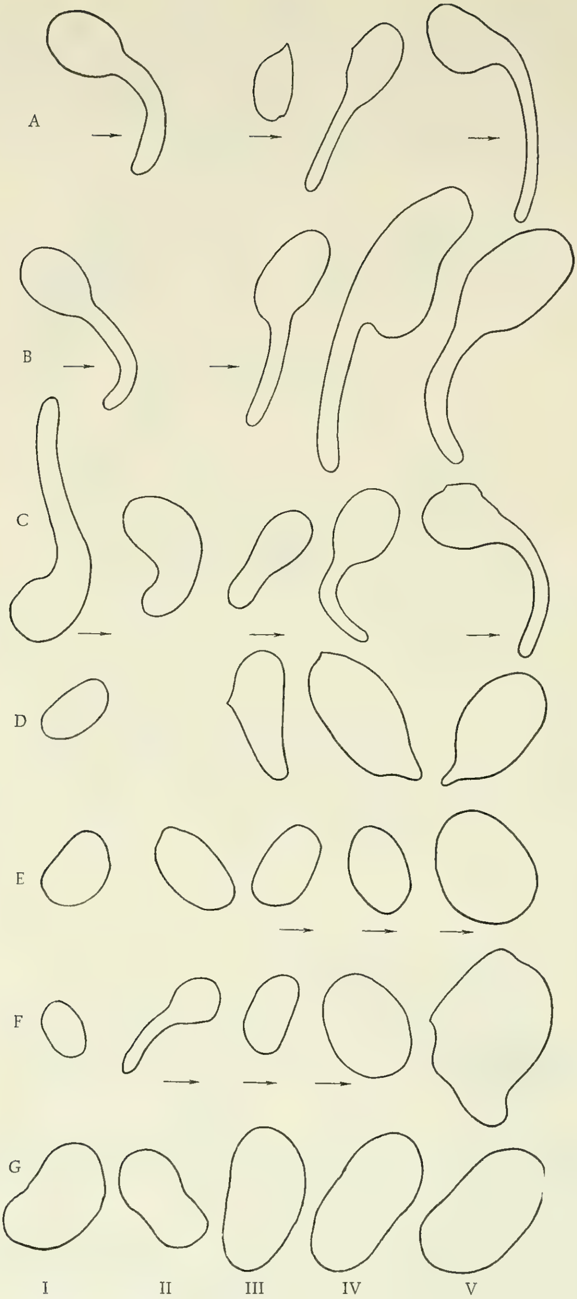

FIGURE 66. Epipodites of legs I — V:

A — Camptocercus lilljeborgi (Sutka River, 11 August 1962); B — C. rectirostris (Cherepovets Reservoir, 16 September 1963); C — Graptoleberis testudinaria (Cherepovets Reservoir, 16 September 1963); D — Oxyurella tenuicaudis (Ivan'kovo Reservoir, 21 July 1962); E — Leydigia australis (after Sars, 1886); F — L. leydigi (Ladka River, 14 August 1962); G — Leydigiopsis curvirostris (after Sars, 1901).

for water (Belyaev, 1950). The hemocytes number many thousands in E. lamellatus and only a few hundred in Acroperus harpae. Many hemocytes are not mobile, since they are situated on the surface of the organs. Most hemocytes are immobile in some conditions (in A. harpae, for example, all the hemocytes may be immobile).

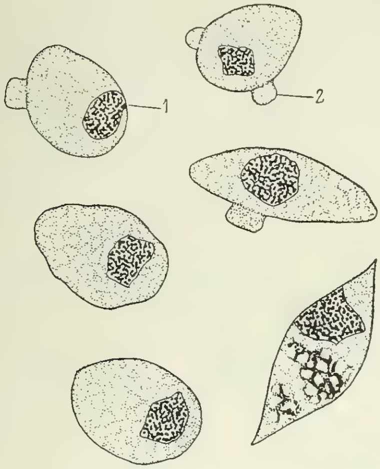

FIGURE 67. Blood corpuscles of Eurycercus lamellatus, female, 2.5 mm long (Rybinsk Reservoir, Borok, 2 August 1963):

1 — nucleus; 2 — pseudopodium.

L. I. Smirnova made blood smears of Eurycercus lamellatus by standard methods and obtained the following picture (Figure 67). Staining after Pappenheim shows the nucleus violet, as in erythrocytes of fish. The cytoplasm is basophilic. The cells are oval, spindle-shaped, and usually of irregular form; they are about 15μ long. Other
55 (small) cells were not found. Many cells have pseudopodia. The nucleus is rounded, with dense chromatin. The position of the nucleus varies. The cytoplasm is vacuolated. The cells circulating in the blood resemble those in the smears.

Excretory system. The excretory organs consist of a pair of maxillary glands (shell glands) which open at the base of the maxillules. The antennal glands, like the maxillary glands, are paired coelomic sacs (part of the secondary body cavity). Staining with brilliant cresyl blue, methylene blue, neutral red, eryocyanin, or vital "Neurot" [new red] showed these glands in Eurycercus lamellatus and Chydorus sphaericus (Dejdar, 1930b; Gicklhorn, 1931b). The antennal glands have no efferent duct, as was shown in Eurycercus lamellatus. Anchistropus has a gland which discharges at the tooth-shaped process on the ventral side of the valves (Figure 68).

Genitalia. The ovaries are situated on both sides of the intestine; each ovary ends posteriorly in an oviduct which opens in the brood pouch. The ovary consists of several lobes. Each lobe contains 4 cells, one of which develops into an egg while the other three are nutritive cells which are resorbed during development (in Eurycercus lamellatus; Weismann, 1877). The differentiation of the 4 cells into an egg and nutritive cells takes place before ovulation of the older generation of oocytes (in E. lamellatus; Makrushin, 1965, 1966). The latent eggs leave the ovary and reach the brood pouch only after fertilization; if fertilization does not take place, several ephippia without eggs are formed and deposited in rapid succession. This was reported in Chydorus sphaericus by Scourfield (1898) and we found it in Eurycercus lamellatus. There are many (to 40) parthenogenetic (subitaneous) eggs in Eurycercus and Saycia, and only 2 in other species. The resting (latent) eggs are enclosed in a primitive ephippium formed by the valves or by parts of them (Figures 157 and 158). Ephippia of the Chydoridae have been described by Scourfield (1902). The ephippium of Leydigia acanthocercoides contains the detached

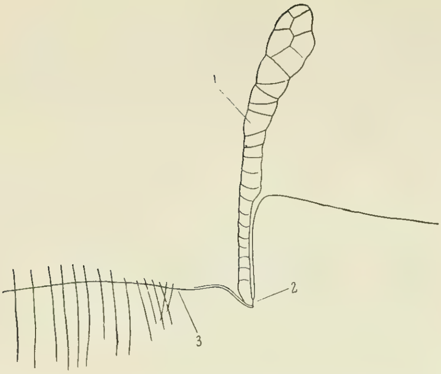

FIGURE 68. Gland of valve of Anchistropus emarginatus, ventral margin of right valve, outer view (Angara River, Irkutsk Region, 23 August 1952). Length of gland 75µ:

1 — gland; 2 — efferent opening; 3 — anterior part of ventral margin of valve.

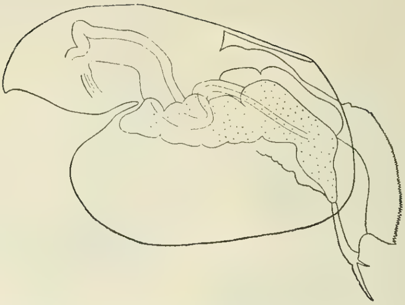

FIGURE 69. Testis of Eurycercus lamellatus (after Weismann, 1880) (dotted area)

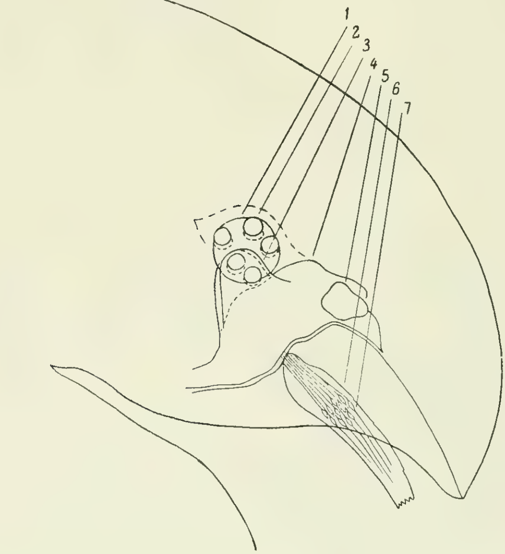

FIGURE 70. Head of female of Acroperus harpae (Rybinsk Reservoir, July 1965):

1 — eye; 2 — ommatidia; 3 — processes of cephalic ganglion; 4 — cephalic ganglion; 5 — ocellus; 6 — antennule; 7 — ganglia of antennule.

ventral margins of the valves (Scourfield, 1899, 1902; Figure 158). The ephippia of Eurycercus and Saycia contain several eggs, but those of other Chydoridae contain only one. According to data from the Rybinsk Reservoir, the ephippia of Eurycercus lamellatus contain from 4 to 11 eggs.

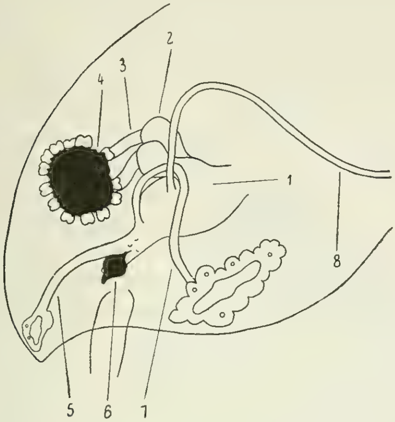

FIGURE 71. Brain of Eurycercus lamellatus (after Leydig, 1860):

1 — cephalic ganglion; 2 — its dorsal process (eye ganglion); 3 — optic nerves; 4 — eye; 5 — rostral nerve; 6 — ocellus; 7 — nerve of head shield; 8 — posterior nerve.

The brood pouch is a space situated above the dorsal side of the body and covered by the valves. The posterior surface of the dorsal side of the body of E. lamellatus bears a process which closes the brood pouch. This process was illustrated by Baird (1850, Plate XV, Figure 1k).

In ephippial females of E. lamellatus, the epithelium on the dorsal side of the segments which faces the interior of the brood pouch functions as a gland which secretes the ephippium; the valves also take part in the formation of the ephippium (Makrushin, 1967, 1968).

The testes are situated on both sides of the intestine and are divided into several communicating cavities. The seminal duct, which discharges in the postabdomen, begins at the boundary between thorax and postabdomen (Figure 69). The vas deferens may open dorsal to the base of the claws, ventral to them, near the base of the claw, or some distance from them. The spermatozoa are spherical (Weismann, 1880; Herrick, 1884), with diameters as follows: Eurycercus lamellatus 5μ, Camptocercus rectirostris 1.6μ, Acroperus harpae 3μ, Alonella nana 1.4μ, Graptoleberis testudinaria 2μ, and Pleuroxus truncatus 0.5μ (Weismann, 1880). Lilljeborg (1900) suggested possible hybridization between Chydorus sphaericus and Pleuroxus laevis. Interbreeding of two clones of P. denticulatus from Florida and Minnesota was obtained by Shan and Frey (1968). The beginning of gamogenesis was controlled by changes in the photoperiod, since the Florida forms are gamogenetic at a long photoperiod and the Minnesota forms at a short photoperiod. This indi-
56 cates an adaptation to extreme local factors and genetic differentiation, even though the animals belong to the same species. The Florida and Minnesota populations differed slightly in sculpture and form of the shell. Ephippial

females were obtained from a parthenogenetic female from Florida after three weeks of culture in dishes containing 6 ml of filtered lake water and illuminated for 16 hours daily at 17–21° C. The ovaries of the females contained large haploid eggs. However, they did not enter the brood pouch and, since males were absent, the females deposited empty ephippia. Males were obtained from Minnesota material cultured under continuous illumination. Interbreeding took place on glass slides with hollows containing 1 ml of water of the Florida culture. A recently molted female and two males were placed in each hollow. Copulation soon took place, and the slides were placed in the same conditions as the Florida clone. On the following day a gametogenetic egg entered the brood pouch; a day later there was a molt and the embryo entered the ephippium. Each interbreeding resulted in one ephippium with a single egg. Eleven eggs obtained in this manner were placed under continuous illumination. Progeny was produced in 21–40 days. Four normal specimens and two abnormal ones were obtained. One developing egg produced no progeny, while four eggs did not develop. The normal hybrids showed some male characteristics. The four normal specimens lived for 6–11 days (they usually live much longer); they molted twice and attained stage III (usually stage I), but their ovaries did not develop. The abnormal specimens lived for 4 and 2 days without molting. The developing egg which did not produce progeny contained an embryo which was smaller than normal. The small progeny of the hybrid eggs, the tendency to abnormalities, and the fact that the ovaries did not develop suggest genetic differentiation between two populations of the same species; this differentiation makes interbreeding difficult.

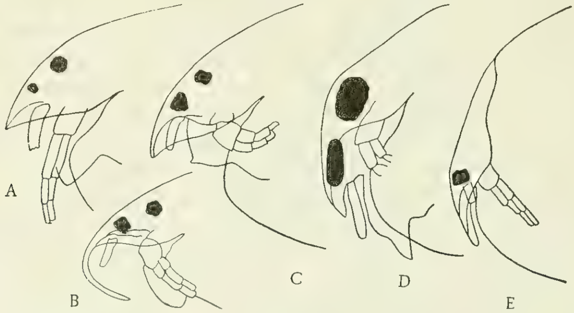

FIGURE 72. Eyes:

A — eye larger than ocellus (Acroperus elongatus); B — eye and ocellus of about equal size (Rhynchotalona falcata); C — eye smaller than ocellus (Leydigia leydigi); D — large eyes (Dadaya macrops, after Brooks, 1959); E — only ocellus present (Monospilus dispar).

Gynandromorphism (androgonism), a condition in which an individual shows sexual characters of both sexes, is known in Biapertura affinis. Ramułt (1930b) found a specimen of B. affinis with a developed embryo and with hooks on the first pair of legs. The armature of the dorsal side of the postabdomen was intermediate, i.e., anal denticles were present, but there were only a few of them. Kurz (1874) described a specimen of

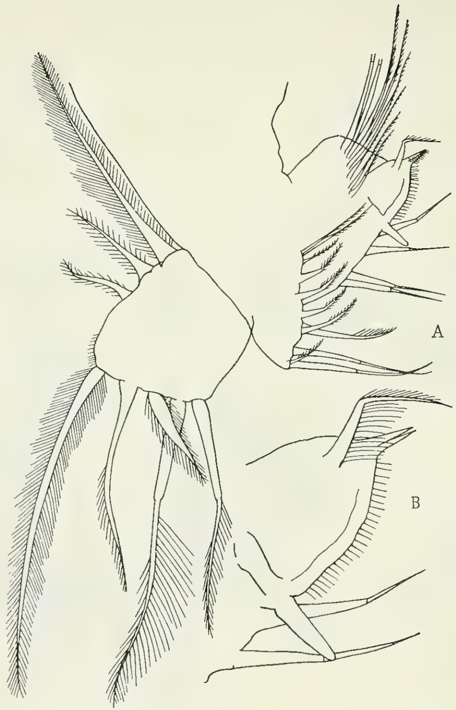

FIGURE 73. Leg III (left leg, inner view) of male of Eurycercus lamellatus. Length of sensilla 24μ (Rybinsk Reservoir, 2 October 1962):

A — general view; B — gnathobase with sensilla.

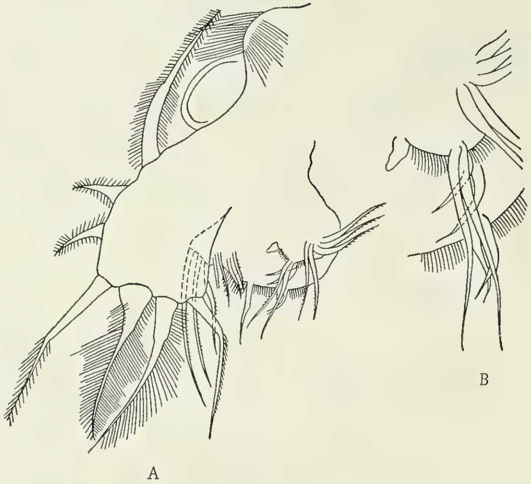

FIGURE 74. Leg III (left leg, inner view) of male of Pseudochydorus globosus. Length of sensilla 12μ (Cherepovets Reservoir, mouth of the Kovzha, 20 October 1963):

A — general view; B — sensilla.

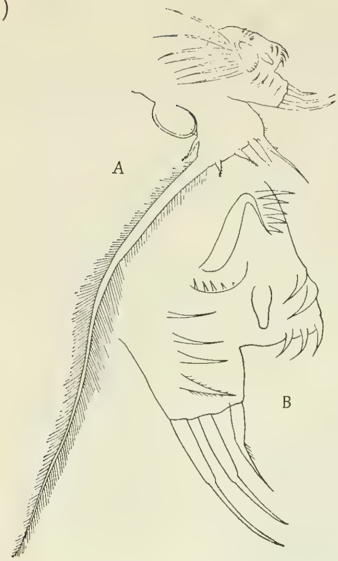

FIGURE 75. Leg III (left leg, inner view) of female of Alona quadrangularis. Length of sensilla 8μ (Ladka River, 14 August 1962):

A — general view; B — endite with sensilla.

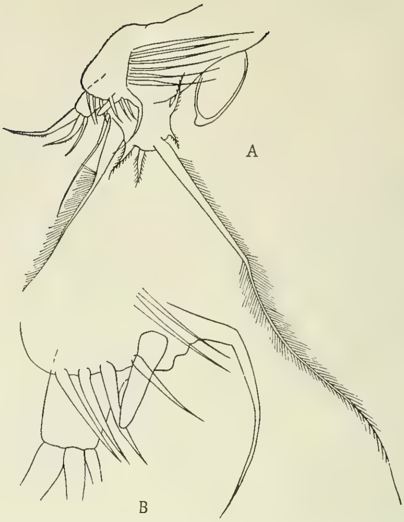

FIGURE 76. Leg III (left leg, outer view) of male of Biapertura affinis. Length of sensilla 12μ (Cherepovets Reservoir, 21 October 1963):

A — general view; B — sensilla.

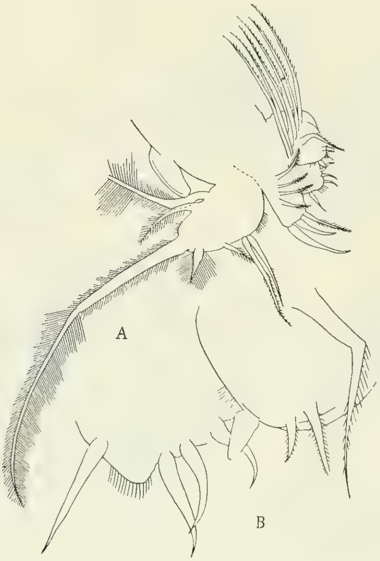

FIGURE 77. Leg III (left leg, inner view) of female of Tretocephala ambigua. Length of sensilla 11μ (Lenkoran' district, Mashikhanskii pond, 25 May 1963):

A — general view; B — sensilla.

Alona quadrangularis with a vas deferens on the left and ovaries on the right. True gynandromorphism should be distinguished from age-linked changes in the males, since immature males resemble females (Smirnov, 1967c).

Nervous system. Little is known about the structure of the nervous system. This is unfortunate because of the interest in the nervous system in connection with the possible role of neurosecretion in the control of molts, reproduction, behavior, and other processes. The cephalic ganglion and the nerves originating from it are relatively well known (Figures 70 and 71). Leydig stated that the brain of Eurycercus lamellatus consists of a right and a left half; each half bears a process which in all species examined is fused at the end with the process of the other side and forms the optic ganglion. However, strangely enough (and probably in all Chydoridae), a common optic ganglion does not develop. Moreover, each of
59 these processes is rounded and slightly widened and gives rise to a bundle of optic nerves so that, strictly speaking, there are two optic ganglia . . . In addition to the optic nerves, the following nerves originate on the brain: 1) a distinct nerve which extends toward the head shield, its end forming a large pale body with lobed margin; this nerve contains numerous light nuclei and a sharply defined, centrally situated annular part which also has undulate margins and is highly refractile . . . ; 2) a nerve directed toward the end of the rostrum like the preceding nerve, but with a smaller end plate . . . ; 3) a nerve which extends posteriorly and can be traced for a long distance but the ending or destination of which could not be determined (Leydig, 1860:213). Acroperus harpae is another species in which the dorsal processes of the cephalic ganglion do not become fused (Figure 70). In Alonella excisa, the ganglia in the antennules and at the natatorial setae are distinctly visible without special treatment. Fibers from the esthetascs and setae of the antennules extend to the ganglia. There is a large, distinct mass of ganglia at the natatorial setae of Acroperus harpae.

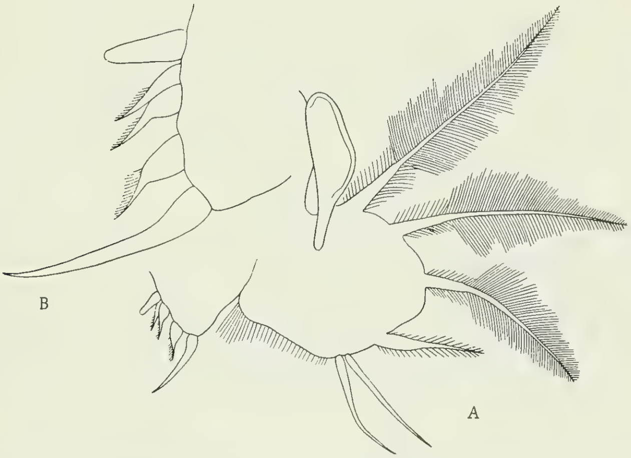

FIGURE 78. Leg IV (left leg, outer view) of male of Biapertura affinis. Length of sensilla 9μ (Cherepovets Reservoir, 21 October 1962):

A — general view; B — sensilla.

Sense organs. The ocellus (pigment spot, nauplius eye) is situated at the base of the antennule. The eye is situated above the ocellus near the margin of the head (Figures 70–72). The ocellus and eye are single. Monospilus has no eye (Figure 72). The ocellus may be larger than the eye (Leydigia, Figure 72); it has no ommatidia. Vital staining has shown that the eye pigment is soluble in the following solution: 3 parts 10% NaOH, 3 parts pyridine, 10 parts 30% glucose. Solution may be obtained in fresh and in formalin-fixed material. The ommatidia can be easily counted in eyes thus treated. There are 28 ommatidia in both sexes of Eurycercus lamellatus. Ten ommatidia have been found in the following species of the subfamilies Chydorinae and Aloninae: Pleuroxus trigonellus, P. truncatus, P. aduncus, Alonella excisa, Disparalona rostrata, Pseudochydorus globosus, Biapertura affinis, Alona rectangula, Graptoleberis testudinaria, Leydigia leydigi, and Acroperus harpae (Figure 70). The eye is situated above the cephalic ganglion, partly between the dorsal processes of the ganglion. The ocellus is situated on the anterior part of the cephalic ganglion. The facets of Chydorinae and Aloninae do not surround the eye, but there are 5 of them on each side, in the anterior and posterior part of the eye. A refractile body has been found only in the ocellus of Eurycercus lamellatus (Leydig, 1860). Jurine (1820) and Baird (1850) hold that the ocellus is not an organ of vision.

The esthetascs or sensory papillae are appendages of the antennules which taper slightly distally and have a thin integument. Females have 9 esthetascs on each antennule, and males 9 or 12 (Scourfield, 1896b, 1905); the male of Eurycercus lamellatus has numerous esthetascs (Figure 9). All or most of the esthetascs are situated on the apex of the antennule, but
60 in some species 1–2 esthetascs are situated some distance from it (Scourfield, 1896b). The esthetascs are almost of the same length, or some are much longer than the others. The esthetascs are considered as chemical sense organs. The antennules are directed anterolaterally, and the esthetascs extend from its apex in all directions in the form of a bundle. Some of the esthetascs of Biapertura affinis are much longer than the others; the short esthetascs reach to the margin of the apex of the rostrum without projecting beyond it, but the long esthetascs project far beyond the margin of the rostrum and are possibly tactile organs for feeling more distant objects. The length of the antennae and esthetascs as a percentage of the body length is much greater in the male than in the female (Figure 105). The antennules of the male also bear an additional sensory seta and often a greater number of esthetascs.

Some of the setae of the antennae, antennules, and legs are evidently tactile. Rows of setae which correspond to the folds (or segments) are situated on the dorsal side of the abdomen. Leydig (1860) illustrates these setae in Eurycercus lamellatus, Leydigia leydigi, Acroperus harpae, and A. elongatus. In lateral view these rows of setae appear as a single seta or as a bundle originating from one point. These rows of setae are best visible in a preparation of the abdomen, dorsal side upward (Figure 502).

Fryer (1963b) described sensillae on the legs of Eurycercus lamellatus (Figure 79). Such sensillae are found on legs III and IV of many Chydorinae and Aloninae (Figures 73–78; Smirnov, 1967a). A male of Eurycercus lamellatus of length 1.9 mm has a sensilla 24μ long. The length of the sensilla ranges from 8 to 16μ in other forms which are 0.6 to 1 mm long. The sensilla is an elongate papilla with a blunt apex, a slightly widened base, and a thin integument (formalin-fixed material). The sensillae are situated on the endite near the gnathobase. Macrothrix laticornis (Jurine) of the closely related family Macrothricinae also has sensillae on the legs. We found a large sensilla on leg II of M. laticornis; there is certainly no sensilla on leg II of the Chydoridae examined by us. As in the Chydoridae, the distal part of the sensilla of Macrothrix laticornis contains highly refractile bodies. Although these sensillae have only recently been described, they are shown in some drawings by earlier workers. For example, there is a distinct sensilla on leg III of the female of Eurycercus polyodontus in the work of Dybowski and Grochowski (1898b). The sensillae of the legs are directed into the space between the legs of the right and left side; they are in contact with the current directed toward the mouth and are obviously taste organs.

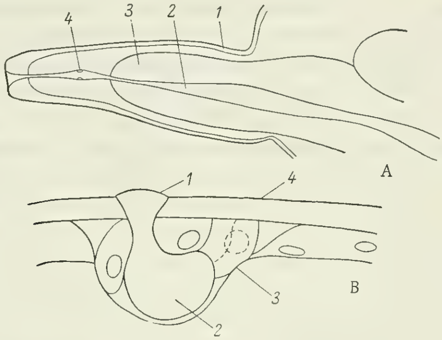

FIGURE 79.

A — sensilla of leg IV of Eurycercus lamellatus (after Fryer, 1963b): 1 — cuticle, 2 — nerve, 3 — cover cell, 4 — refractile body; B — anterior main head pore of Chydorus sphaericus, sagittal section showing the pore, its cavity, the cuticle, and the epithelial lining (after Franke, 1934): 1 — pore, 2 — cavity, 3 — epithelial cells, 4 — chitinous layer.

Head pores. An internal organ is associated with the head pores of the integument. Silver nitrate is reduced near the head pores (Dejdar, 1930a). We could observe some structural details of the head pores with this method. The species of Alona have canals which extend from the small pores into the tissue (Figures 63 and 64). In Eurycercus, canals also extend from the small pores near the main pore inward and anteriorly (Figure 59). In the head pores of the Chydorus group we could only stain the pore area without any canals (Figures 59 — 61). The main pore leads into a cavity (Figure 79). In Acroperus harpae there are 3 cavities corresponding to the 3 main pores which become visible in a few minutes after staining with 10% bromcresol purple, but the stain disappears rapidly. The main head pores are situated strictly in the median vertical plane of the body. Even in the keeled forms the margin of the keel is slightly widened to accommodate the head pores (Figure 483).

61 VARIABILITY AND STABILITY OF CHARACTERS

The Chydoridae are on the whole bilaterally symmetrical. Asymmetry is present in the structure of the posteroventral corner of the valves (Figure 545) and in the arrangement of the anal and lateral denticles (Lilljeborg, 1900; Harding, 1955) (Figure 429). The left and right mandibles are different and their musculature is also asymmetrical (Fryer, 1963b). Brehm (1925b) stated that important specific characters vary markedly in the same species, e.g., the armature of the postabdomen, the form of the rostrum, the sculpture of the valve and the posteroventral corner of the valves. The number of denticles on the posteroventral corner of the valves may vary in the same population, or denticles may be absent (Figure 231). The armature of the posteroventral corner of the valves varies markedly. Accidental factors apparently determine the embryonic development of the posteroventral corner of the valves, so that the number of denticles cannot be used as a taxonomic character, but their general form and variation may be included in the description of species. This character may also show some stability. Some specimens of Acroperus elongatus retain several molted valves, so that a comparison of the number of denticles on the posteroventral corner of the valves in different stages of development can be made. In this case, all valves of one side have the same number of denticles; if a valve has 2 denticles, then this number remains the same. However, the number of denticles varies in the progeny of a female (Spandl, 1923b): a female of Pleuroxus truncatus with 12 denticles on the valve produced a progeny in which the number of denticles varied from 11 to 20.

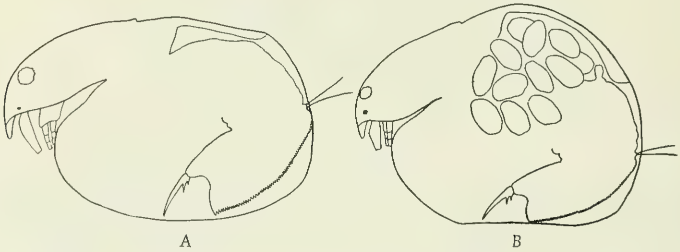

FIGURE 80. Age-linked changes of the form of a female of Eurycercus lamellatus (Rybinsk Reservoir, Borok, 31 July 1965):

A — length 1.0 mm, ratio of height to length 1:1.5; B — length 2.6 mm, ratio of height to length 1 : 1.3.

Sexual dimorphism is quite distinct. It is seen in the size and form, the structure of the postabdomen, the skeletal structures, the antennules, legs and the length of the rostrum. The sexes usually differ in the number of anal denticles and the number of basal spines of the claw. Legs II—V do not show sexual dimorphism. Males are smaller than females. The antennules of the male are larger than those of the female and usually bear a greater number of setae and esthetascs (Figure 9). The endopodite of legs I of the male bears a hook which is used to attach to the valves of the female. Opposite the hook, the endite bears a brush of hard setae. The postabdomen of the two sexes differs in form, but the degree of difference varies in the different species. The males of 50% of the species of Chydoridae are known. All males of species examined under stable conditions or by repeated examination are known.

Age-linked morphological changes are present in both sexes. In Eurycercus lamellatus, the ratio of length to height varies with age (Figure 80). However, the corresponding ratio in Acroperus harpae hardly changes with age (Werner, 1924). Among the age-linked changes in the female is the progressive lengthening of the posterodorsal corner of the postabdomen, notably in Pseudochydorus globosus, Tretocephala ambigua, and Kurzia longirostris. The position of the head pores is also dependent on age; the ratio of the distance between the head pores and the distance from the posterior pore to the posterior margin of the head shield in Pleuroxus aduncus and P. striatus increases with age to a maximum and then decreases slightly (Figure 81; Smirnov, 1964). There are distinct individual variations. An increase in the distance from the pores to the posterior margin of the head shield with age is present in P. truncatus but not in Acroperus harpae (Werner, 1924). The form of the brood pouch of the female of Eurycercus lamellatus (Figure 82) also changes with age.

62 Some forms combine characters of both sexes and are small. Such forms have vasa deferentia and testes but no embryos. These are young males. We are dealing here with age-linked morphological changes of the male (in contrast to the gynandromorphs). Age-linked morphological changes of the male were described by Lilljeborg (1900, Plate XXIV, Figures 18 and 23, Plate XXVII, Figures 15 and 19). Juvenile males have been described recently by Flössner (1962a). Such juvenile males are rare, probably due to the fact that males are present only during a restricted part of the growth period; the juvenile males grow rapidly into adults. Examination of a large number of specimens for several years always showed juvenile males.

On the whole, the morphology of the juvenile males resembles that of females (Figures 208 and 214). This is seen in the form of the postabdomen and the fact that there are anal denticles. The vasa deferentia of the juvenile male open in the proximal part of the postabdomen, but these openings are displaced to the distal end of the postabdomen in the adult. The rostrum and antennules of the juvenile males resemble those of the female in size and relationships. The juvenile male of Leydigia leydigi has no penis-like process; its vas deferens opens on the ventral side of the postabdomen some distance from the base of the claw (Figure 557).

The postabdomen of adult males is greatly modified; the vasa deferentia open near the distal end of the postabdomen. The anal denticles disappear; their presence would prevent the introduction of the postabdomen below the valves of the female. The antennules protrude far beyond the apex of the short rostrum.

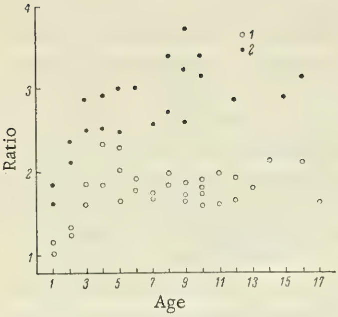

FIGURE 81. Effect of age on the ratio between the distance from the posterior pore to the posterior margin of the head shield and the distance between the pores:

1 — Pleuroxus aduncus;
2 — P. striatus.

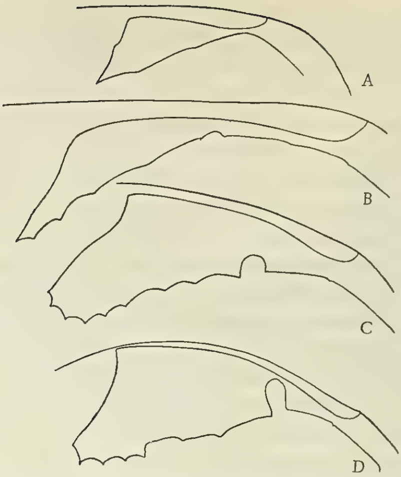

FIGURE 82. Age-linked changes of the brood pouch of a female of Eurycercus lamellatus (Rybinsk Reservoir, near Borok, 31 July 1965):

A — juvenile, length 0.74 mm; B — length 1.26 mm; C — length 1.69 mm; D — length 2.70 mm.

The age-linked variation of the males is evident also in cultures. During cultivation of Pleuroxus trigonellus (in half-liter jars with decomposing macrophytes), juvenile males appeared at a density of about 1,000 organisms/liter (Figure 83). Adult males appeared 3 days later in numbers corresponding to those of the young males observed previously. Many of the adult males had only recently shed their exuviae. The adult males which predominated after a further 3 days were as numerous as the sum of the juvenile and adult males found in the preceding observation. Mortality was low. Preparations of a juvenile male of P. trigonellus show the developing adult postabdomen inside the juvenile postabdomen.

63 Changes in the length/height ratio in different seasons were observed in Chydorus sphaericus (Figure 84; Stingelin, 1895). Negrea (1966a; 139) found cyclomorphosis in Camptocercus rectirostris.

Deformities of various parts of the body are common in Chydoridae. They may be of embryonic origin or the result of traumata during postembryonic development. The deformities concern the postabdomen, the claws, and the arrangement of the anal spinules; the claws are sometimes missing or the form of the posterior margin of the valves is changed (Figures 85—102). A common deformity in the arrangement of the anal denticles is the division of the continuous row into a distal and proximal part, e.g., in Alona costata, A. quadrangularis, Alonella excisa, and Biapertura affinis (Figures 85—95; Shikleev, 1930a, 1930c; Ramułt, 1930a; Flössner, 1962a). The deformities of the anal denticles involve a decrease in their number and never an increase. Deformities of the legs are very rare. Fryer (1963b) observed a double hard seta on the endite (near the gnathobase) of the right leg IV of Eurycercus lamellatus. The cause of

63 the deformities is largely unknown. In one case, a deformity of the postabdomen of Pleuroxus truncatus was due to endoparasites (Stromenger-Klekowska, 1961). Observations of deformities under different conditions or in special experiments (Rammner, 1930; Jančařík, 1946) may explain the role of external or internal factors in the differentiation of forms.

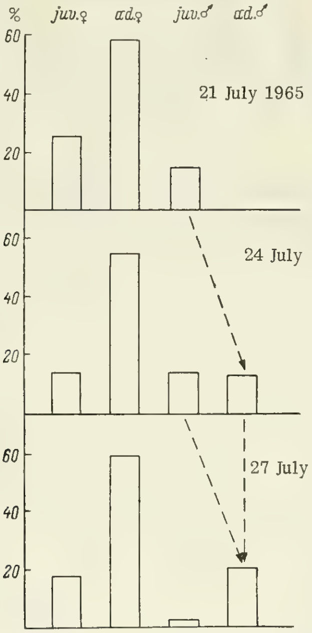

FIGURE 83. Percentage of juvenile and adult females and males in a culture of Pleuroxus trigonellus. The counts were made at the appearance of the juvenile males and their transition to the adult form. The arrows show the transition of some groups into others.

Deformed or aberrant individuals are usually a small minority of the population. Thus, out of 100 individuals of Acroperus elongatus taken at random from the Ivan'kovo Reservoir (22 July 1962) 2 specimens had 2 denticles on the posteroventral corner of the left valve (and one denticle on the right valve), one had a less developed denticle on the right valve, and another had a deformed claw. Of 100 specimens from the Uglich Reservoir (23 July 1962), one had a deformed claw, 3 a deformed postabdomen, and 5 an abnormal number of spinules on the posteroventral corner of the valves (one specimen with 2 on the left and one on the right valve, one with one spinule on the left and 2 on the right valve, 3 with one spinule on the right valve and none on the left). The deformities of the postabdomen of Pleuroxus laevis (Figure 85) correspond to those described by Berg (1929–1930).

According to unpublished data of Frey, head shields without pores occur in Alona quadrangularis and Chydorus.

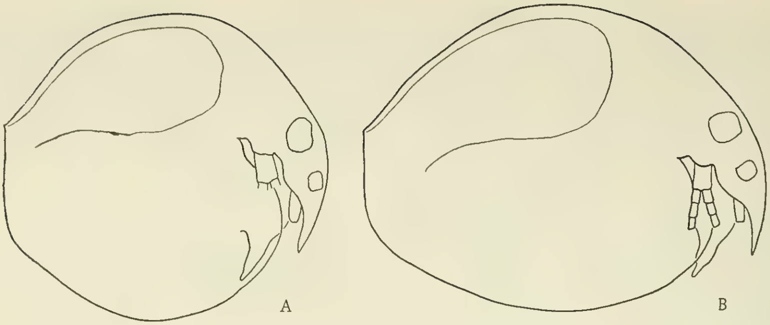

FIGURE 84. Extreme forms of Chydorus sphaericus (after Stingelin, 1895); the height of the two drawings is the same. Ratio of height to length is 1 : 1.01 in specimen A, 1 : 1.30 in specimen B.

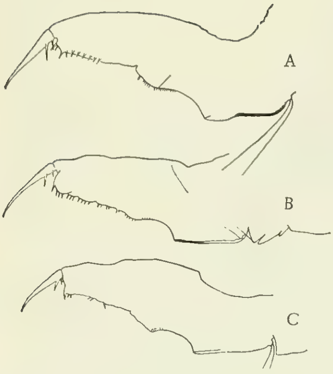

FIGURE 85. Deformed postabdomen of a female of Pleuroxus laevis:

A — Cherepovets Reservoir, Goritsy, 21 October 1963, preparation 966; B — Il'd River, 10 August 1962, preparation 734; C — Cherepovets Reservoir, near the dam, 5 September 1964, preparation 588.

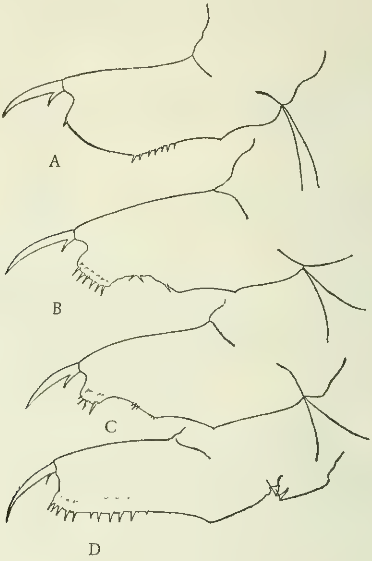

FIGURE 86. Deformed postabdomen:

A — Alona quadrangularis (after Flössner, 1962a); B, C — A. costata (after Flössner, 1962a); D — A. costata (lake near Pechora River, near Lemtybozh, 7 July 1963, preparation 724).

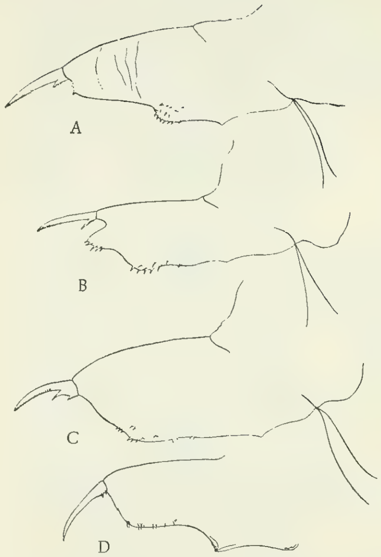

FIGURE 87. Deformed postabdomen:

A—C—Biapertura affinis (after Flössner, 1962a); D—Chydorus sphaericus caelatus (Lake Kadil'noe, coast of Lake Baikal near Bol'shie Koty, 21 March 1964, preparation 1607).

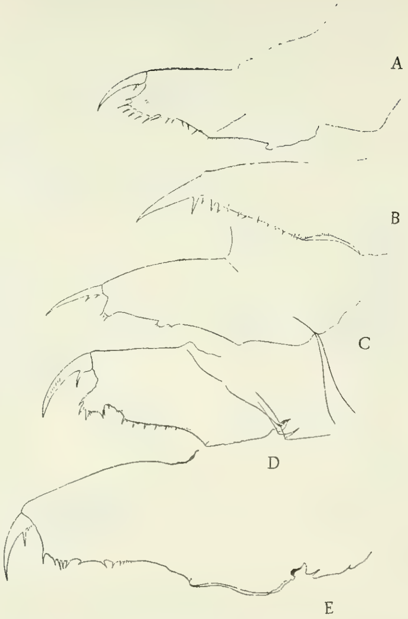

FIGURE 88. Deformed postabdomen:

A–Alona costata (after Shikleev, 1930b); B–Pleuroxus trigonellus (after Vereshchagin, 1929); C – Alonella excisa (after Flössner, 1962a); D – Alona guttata (Shugor River, Komi ASSR, 10 August 1963, preparation 1796); E–Alonella exigua (Nibel', Pechora Basin, 1 September 1965, preparation 2276).

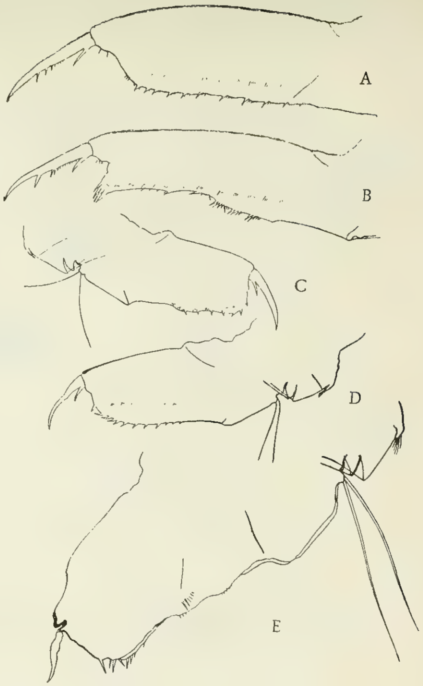

FIGURE 89. Deformed postabdomen:

A – Acroperus elongatus (Uglich Reservoir, 23 July 1962, preparation 145); B – as above, preparation 486; C – Alona costata (Uglich Reservoir, 23 July 1962, preparation 723); D – A. costata; E – female of A. davidi punctata (White Nile, 27 January 1964, preparation 6).

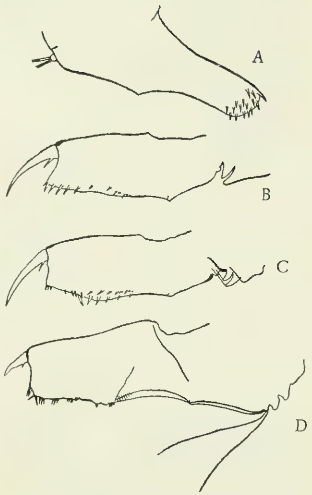

FIGURE 90. Deformed postabdomen:

A — Phrixura rectirostris P. E. Müller, 1867; B — Alona costata (Lake Kadil'noe, coast of Baikal north of Bol'shie Koty, preparation 1418); C — as above, preparation 1259; D — Pleuroxus aduncus (Rybinsk Reservoir, Borok, 30 September 1965, preparation 1953).

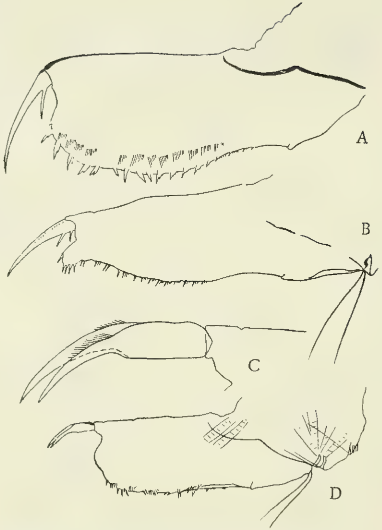

FIGURE 91. Deformed postabdomen and claws of female:

A — Alona quadrangularis (Cherepovets Reservoir, Kolenets-Levinskoe, 6 September 1964, preparation 18); B — Pleuroxus truncatus (Sunozhka River, 9 August 1962, preparation 1608); C — claw of specimen (D); D — Biapertura affinis (Rybinsk Reservoir, Borok, 2 October 1962, preparation 25).

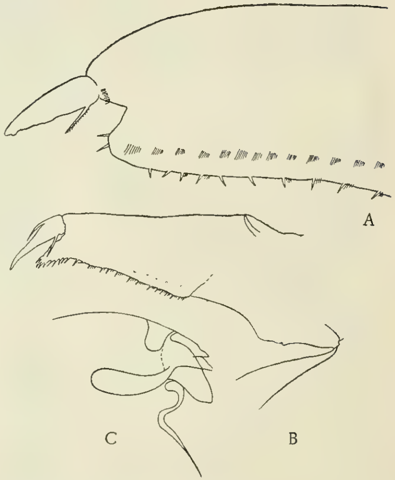

FIGURE 92. Deformed claws:

A — Acroperus elongatus (Ivan'kovo Reservoir, 22 July 1962, preparation 263); B — Pleuroxus truncatus (Cherepovets Reservoir above Goritsy, 16 September 1963, preparation 714); C — Biapertura affinis (after Meuche, 1937a).

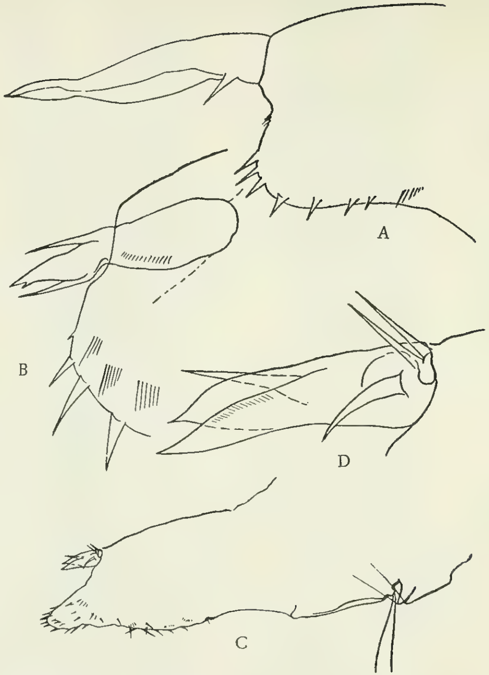

FIGURE 93. Deformed postabdomen and claws:

A — distal part of postabdomen of Chydorus sphaericus (Lake Kadil'noe, coast of Baikal north of Bol'shie Koty, 21 August 1964, preparation 1612); B — Biapertura affinis (Rybinsk Reservoir, Borok, 13 August 1965, preparation 1831); C — postabdomen of Pleuroxus truncatus (Severnaya Mylva River, Komi ASSR, 27 July 1964, preparation 1674); D — claw of same specimen.

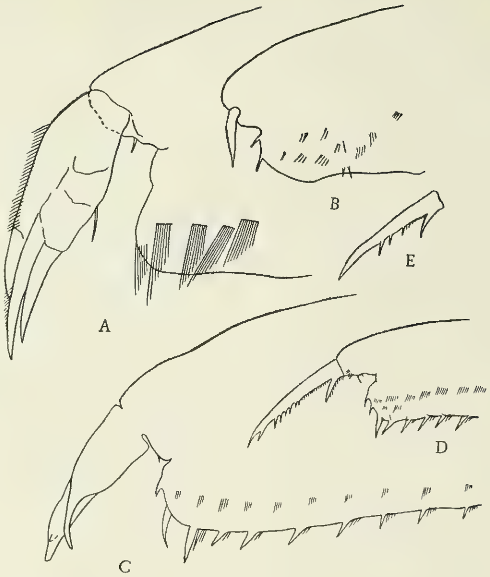

FIGURE 94. Deformed claws:

A — Acroperus alonoides (Cherepovets Reservoir, 16 September 1963, preparation 1078); B — A. harpae (after Ramult, 1930a); C — A. elongatus (Uglich Reservoir, 23 July 1962, preparation 146); D — deformed left claw and end of postabdomen; E — right claw, preparation 149.

OLIGOMERIZATION

Oligomerization (Dogel', 1954) occurs in a variety of ways in the Chydoridae compared with more primitive groups like the Conchostraca or Sididae.

Oligomerization takes place not only morphologically but also functionally, i.e., on the basis of the relationship between form and function, the evolution of the form-function entity, and the development of the function. Another aspect to be studied is the functional causation of oligomerization.

Oligomerization can be found when forms which are primitive in some morphological characters are compared with specialized forms, or by 68 comparing pairs of appendages of different segments, the appendages of a segment in different groups, or parts of the appendages.

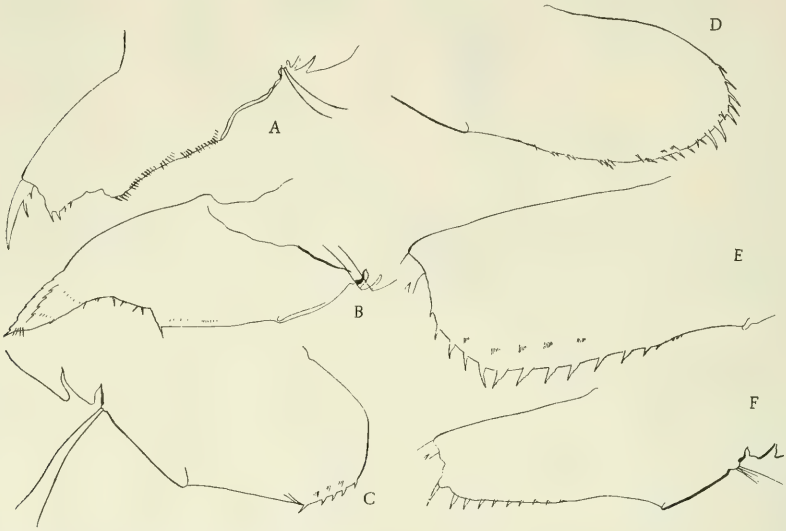

FIGURE 95. Deformed postabdomen:

A – Alonella exigua (Pechora River, Kuz'dibozhskaya Kur'ya, 15 July 1963, preparation 2062); B – Alona costata (Pechora River near Kuz'dibozha Village, 15 July 1963, preparation 1798); C – A. costata, female with embryos (Nibel' River, Pechora basin, Dzh"er-Nyur, August 1965, preparation 2060); D – Biapertura affinis (Lake Lebyazhskoe, Vychegda basin, 19 August 1966, preparation 2277); E – B. affinis (Rybinsk Reservoir, Borok, 8 September 1964, preparation 945); F – Alona costata (oxbow lake near Lem'yu River, Pechora basin, 12 August 1966, preparation 2275).

Comparison of legs II and III, III and IV, and IV and V shows oligomerization of the setae of the legs; the rows of homologous setae are most complete on leg III (where endite and exopodite are of about the same size). Oligomerization on the legs can also be found by comparison of different genera and also by comparison with other families.

The number of setae on all appendages varies in the different groups. Eurycercus and Saycia are most primitive because their appendages bear the greatest number of setae.

The antennae of the Cladocera consist of a segmented base and two rami with 2–4 segments. The segments of the rami may bear one or several setae, or the proximal segments may have no setae. The number of setae

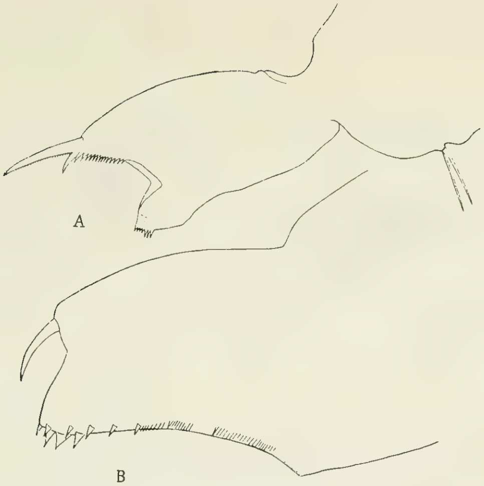

FIGURE 96. Deformed postabdomen of females:

A — Eurycercus lamellatus (after Meschkat, 1937);
B — Alona guttata (after Meuche, 1937a).

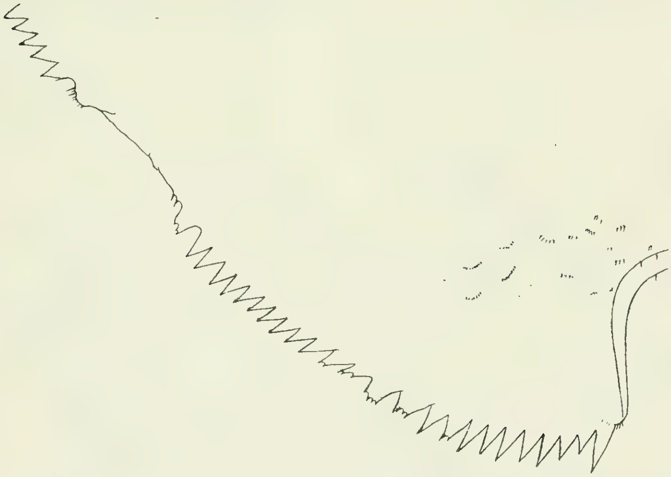

FIGURE 97. Deformed distal part of postabdomen of Eurycercus lamellatus with 56 denticles (Cherepovets Reservoir, 20 October 1963, preparation 1076)

(70)

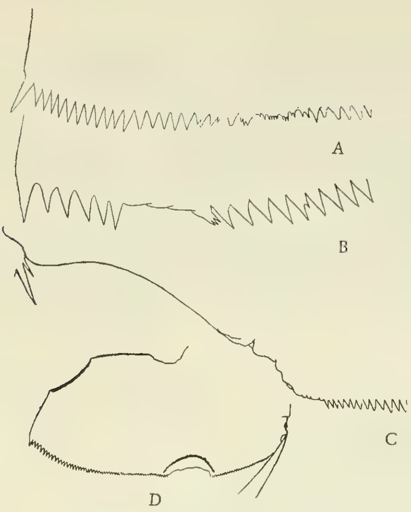

FIGURE 98. Deformed postabdomen of Eurycercus lamellatus:

A — Cherepovets Reservoir, 16 September 1963; B — Cherepovets Reservoir, mouth of the Kovzha, 20 October 1963; C — Rybinsk Reservoir, Borok, 2 October 1962; D — Rybinsk Reservoir, Borok, 16 October 1965, preparation 62.

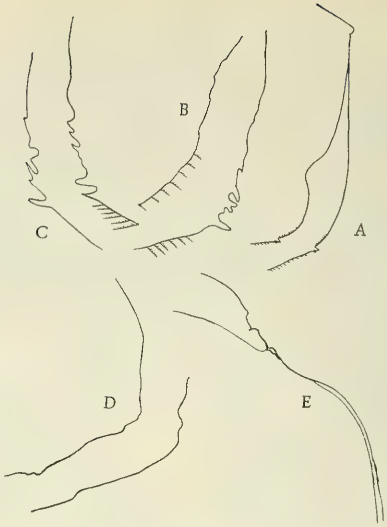

FIGURE 99. Deformed posterior margin of valves:

A — Pleuroxus striatus (Il'd River, 10 August 1962, preparation 1075); B, C — P. truncatus (after Ramułt, 1930a); D — Alona protzi (after Ramułt, 1930a); E — posterodorsal corner of the valves of Camptocercus rectirostris (Sutka River, 11 August 1962, preparation 557).

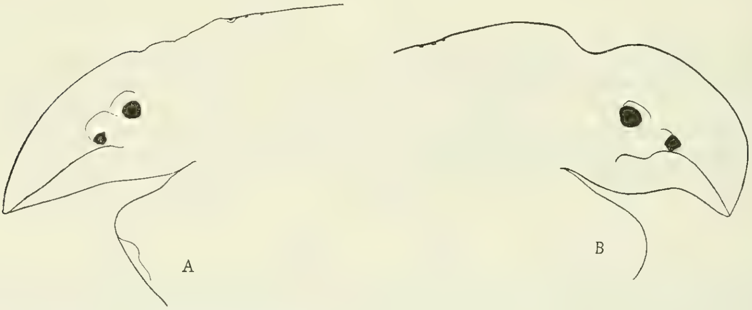

FIGURE 100. Deformed keel of head:

A — Camptocercus rectirostris (Rybinsk Reservoir, 12 July 1962, preparation 31); B — Acroperus harpae (Rybinsk Reservoir, Borok, 28 July 1965, preparation 986; the female contains a developed embryo — proof of successful existence despite the abnormal structure).

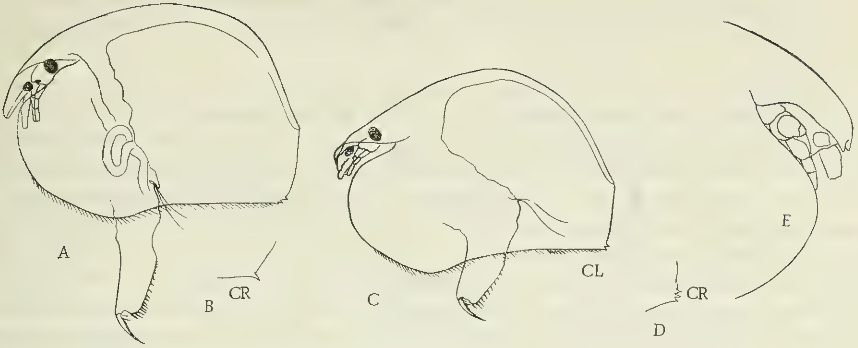

FIGURE 101. Deformed rostrum of females:

A — Pleuroxus trigonellus (Cherepovets Reservoir, September 1964, preparation 1630); B — posteroventral corner of right valve; C — P. trigonellus (Cherepovets Reservoir, 8 August 1963, preparation 393); D — posteroventral corner of right valve; E — Chydorus sphaericus (lake near the Pechora, Lemtybozh area, 7 July 1963, preparation 1286).

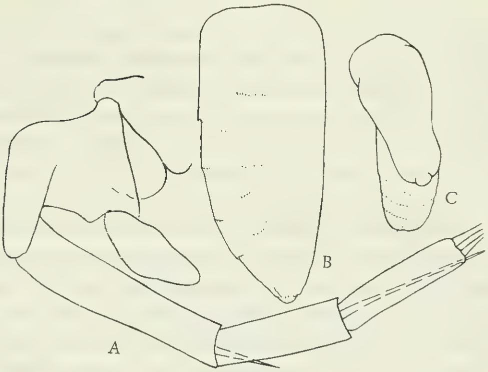

FIGURE 102. Deformed antennae and antennules:

A — left antenna of Acroperus harpae (near Borok, 19 July 1965, preparation 437); B, C — antennules of female of Eurycercus lamellatus (B — left valve, outer view, Cherepovets Reservoir, Kovzha River, 6 km above the mouth, 6 August 1964, preparation 1144; C — right valve, outer view, Sunozhka River, 9 August 1962, preparation 29).

decreases from 8 to 7 in the subfamilies Chydorinae and Aloninae. The rami of the antennae of Leptodora kindti (Focke) bear 26–34 setae, many more than the other Cladocera; only the Sididae may have to 23 setae.

The maxillule bears 3–4 setae in the Chydoridae, 4 setae in the Daphniidae, Moinidae, and Bosminidae, and 20 setae in Sida.

Leg I of the Chydoridae bears 1 or 2 setae on the exopodite. The inner ramus of the endite has slightly more setae in the primitive subfamilies Eurycercinae and Sayciinae. It is interesting that leg I of the Sididae and Holopedidae is not homologous to leg I of the other Cladocera but is homologous to the following legs.

Leg II bears numerous setae in the primitive Chydoridae and fewer setae in the specialized forms. The exopodite of this leg is small in the Chydoridae and bears only a few setae. Leg II of Sida has a fully developed exopodite and resembles the other legs of this group and legs III–V of the Anomopoda.

The number of setae on leg III also varies and is greater in the primitive forms. In the specialized filtering Daphniidae and Moinidae, the gnathobase 72 of leg III bears a fan of numerous setae but the other parts of the leg have primitive characters. The same is true of leg IV.

There are numerous setae on the different parts of leg V of the Eurycercinae and Sayciinae but only a few setae in the Chydorinae and Aloninae. In many Macrothricidae leg V resembles that of the Chydoridae; however, it is greatly modified in other (natatorial) forms. The Daphniidae have a moderately large leg V with a small exopodite which bears only a few setae. In the Sididae, leg I resembles the other legs but it bears slightly fewer setae.

There is a decrease in the Chydoridae from leg III to legs IV and V of the number of the setae on the exopodite, the hard setae of the endite, the soft setae of the endite, and the setae forming the filtering fan on the gnathobase. Oligomerization of these groups of setae becomes evident when the Eurycercinae, Sayciinae, Chydorinae, and Aloninae are compared. The oligomerization of the setae on the exopodites of Leydigia is especially marked.

The decrease in the number of appendages and the gradual reduction in the number of setae on different pairs of appendages represent oligomerization involving different segments. Oligomerization on a certain segment also exists. It consists in the fusion of similar structures, or of oligomerization of structures situated on some appendage of the segment. An example is the oligomerization of the number of setules on the setae of the endites of the legs; there are 11 setules on one of the median hard setae of the endite of leg II of Camptocercus rectirostris, while the corresponding seta of Eurycercus lamellatus bears numerous setules. The setules on the outer ramus of the endite of leg I disappear in Camptocercus, Kurzia, and Alona. These genera form a series with all transitions from a unilaterally feathered, brushlike seta to a hook-shaped one.

The basal spines of the claw of the Cladocera undergo oligomerization. The Sididae and Daphniidae may have several such spines, but the Chydoridae do not have more than two (2, 1, or 0). It is interesting that a reduction of the number of basal denticles occurs independently in the subfamilies

Chydorinae (one, instead of the usual two denticles in Dunhevedia and Dadaya) and Aloninae (the denticle disappears in Leydigia).

Some Chydoridae show a reduction in the number and size of the anal denticles.

An example of oligomerization on the same segment is the fusion of the bases of the natatorial setae in the Daphniidae, Macrothricidae, and Chydoridae. The corresponding structures are separate or partly or completely fused in the Sididae.

Diaphanosoma brachyurum (Liévin) of the family Sididae has one or two eyes. In Monospilus dispar the eye has disappeared and only the ocellus remains. Eurycercus lamellatus has 28 facets, compared with 10 in the Chydorinae and Aloninae. The number of blood corpuscles in the Aloninae is much smaller than in Eurycercus.

Oligomerization also affects the number of genital openings. In Leydigia, the genus with the highest degree of oligomerization of the setae, the males have a single penis. Both sexes of the more primitive genera have two genital openings. Some male Sididae have a paired penis.

The Sididae, Daphniidae, Macrothricidae, Eurycercinae, and Sayciinae develop a large number of parthenogenetic eggs at the same time. There are only 2 such eggs (very rarely 3) in the Chydorinae and Aloninae.

In forms of different taxonomic position and biology, some parts of the legs may show extensive oligomerization while other parts may bear numerous appendages. In the Daphniidae, for example, the exopodites resemble those of the Chydoridae and bear only a few feathered setae; the endites are reduced, although in the Chydoridae they are large and strongly armed. The Daphniidae have a fan of several tens of setae which we consider as belonging to the gnathobase. The corresponding fan of the Chydoridae consists of only a few setae.

The reduction in the number of setae on the appendages is apparently not related to the size of the appendage (at least within the range of sizes present in the Chydoridae). In fact, the endites of Eurycercus lamellatus bear soft setae on legs II, III, and IV. Such setae are absent on the much smaller endite of leg II of the Chydorinae and Aloninae. However, the endite of leg III bears such setae although it is even smaller.

Dogel' (1954 : 350) states that the number of homologous structures is large and variable in the primitive species but decreases and becomes fixed during phylogenetic development. Bening (1912) discusses also the seasonal and geographical aspects of the variation in the number of setae. Harnisch (1949 : 178) found that the filtering fan on the endite and gnathobase of legs III and IV of Ceriodaphnia consists of a large and variable number of setae. However, the number of these setae in the Chydorinae and Aloninae is small and constant.

In some species with numerous setae on the rami of the antennae, the number of these setae varies. In Latona setifera (O. Müller, 1785) of the family Sididae, for example, the proximal segment of the endopodite bears 6 setae in juveniles and to 11 setae in the adults, while the distal segment bears respectively 7 and to 13 setae (Manuilova, 1964. The number of these setae is small and constant in the Chydoridae, Daphniidae, and Macrothricidae. In the primitive Chydoridae, the number of setae
73 varies, but only in a narrow range in some groups. In Saycia cooki from New Zealand there were respectively 10 and 9 setae in the filtering

fan on the gnathobase of the right and left legs V. Eight setae were found in the corresponding position in an Australian specimen. The presence of an abnormal number of hard setae on the endite of leg IV (Fryer, 1963b:378, Figure 53), i. e., 5 instead of the normal 4 on the opposite leg IV of the same specimen, may also be considered as a variation in the number of setae in a primitive form.

This tendency toward oligomerization in the Cladocera is functionally determined. The Ctenopoda, filtrators whose appendages bear filtering fans consisting of numerous setae, apparently developed at an early time. Other groups diverging from the Ctenopoda have undergone specialization. Of these groups, the Daphniidae and Moinidae have retained the method of obtaining food by direct filtration. Their appendages still bear filtering fans consisting of numerous setae. Because of absence of contact with the substrate, their legs I and II and the endites of the other legs are small. The Chydoridae and many Macrothricidae have invaded the bottom of the littoral; they obtain food by scraping and secondary filtration by the endite of leg II of particles already inside the apparatus of the legs. The general tendency toward oligomerization develops a different expression, i. e., the endites of legs II, III, and IV bear more complete complements of setae because of contact with the substrate. Some of these setae, together with those of the gnathobase, form a filtration chamber. The exopodites of legs III, IV, and V and their setae are large and form a pump chamber. Movement on the substrate is made possible by the large size of legs I and their muscles, mainly the enlargement and chitinization of the outer ramus of the endite and its setae.

FUNCTIONAL MORPHOLOGY

The functional approach deals with a group of morphologically different structures which together perform a certain task. During the study of the functional morphology of Chydoridae, particular attention was paid to the spatial relationships between the appendages and other organs or parts of the body (e. g., between the appendages and the lower margin of the valve) within the framework of the general form of the body. The functional relationships between appendages and organs were analyzed. Manton (1961 : 236) also writes of "an analysis of the functional interrelationships between many parts of the same animal." The relationship between a certain structure and the substrate or the environment in which a specific function is carried out was also examined. The comparative approach was also used. A comparison was made between different species of Chydoridae and groups of Cladocera with a different mode of life (mainly between the benthic Chydoridae and the pelagic Daphniidae), and species of primitive groups, because the morphology of Chydoridae can be considered in terms of specialization of primitive structures from their phylogenetic past.

SOME TERMS AND CONCEPTS OF FUNCTIONAL MORPHOLOGY

A satisfactory morphofunctional analysis is impossible without a precise definition of the concept of function. Broadly speaking, this concept means any activity of an organ or organism in contradistinction to structure. However, such an unrestricted and general interpretation of the concept is too vague terminologically. Babskii (1947) gave the following definition: The function is an adaptive vital manifestation of an organ or of an entire organism. Physiologists define function as a manifestation of an organism or of organs, including sense organs, parts of organs, or cells; there are functions performed by different organs and functions of the organism as a whole (Babskii, 1947 : 25). In other words, a distinction is made between more general and more particular functions. Another definition of the concept of function was given by Bock and Wahlert (1965 : 274): In any sentence describing a given structure of the organism, the functions performed by this structure will constitute a class of statements which include all physical and chemical properties which result from its form (i. e., from the composition and arrangement of its material), including the properties which result from a rise of the organization level, provided that any relationship to the environment is not mentioned (for which a separate term exists).

There are thus the following definitions of "function": any life activity of the organism or its parts; the functional aspect of the complex form + function; the performance of a life task by the above complex (for example, movement on the substrate); the "biological role" of Bock and Wahlert (movement on the substrate in search of food or toward an area with better respiratory conditions). We believe that the concept of function should be given a different and more precise definition for the purpose of functional morphology. In our view, the functional-morphological definition
74 of function should be the accomplished performance of an important and essentially integral activity of the organism by a complex of structures. According to this approach, the activity of muscles and sense organs is examined in connection with that of the associated organs. Locomotory movements cannot take place without the respective sensory and motor systems (Manton, 1961 : 239). As functions satisfying this definition we can consider movement (in the Chydoridae — swimming and running), obtaining food, digestion of food, distribution of assimilated food and growth, gas exchange with the environment, gas exchange in the internal organs, excretion, defense of the body and support of other organs, and reproduction.

An examination of the work performed by the appendages of the Chydoridae shows that some functions are carried out by some part of a leg or of several legs, while other functions are performed by several legs together with other parts of the body (Smirnov, 1968a). In other words, functional units do not necessarily correspond to morphological units. The term functional unit (functional complex) refers to a group of structures which perform a certain function. Morphologically different structures may participate in a single activity. Cases in which a functionally homogeneous structure (which therefore is also homogeneous in external appearance) consists of elements of different morphological nature exist also in other invertebrates. Thus, the labrum of chironomid larvae bears a functionally homogeneous fan which consists of chetae and chetoids (i. e., appendages of different morphological nature; Shilova, 1965, Figures 2—1 and 8; 1966).

The term "functional complex" or "functional unit" is not new. It is found in Pontecorvo (1958 : 28, "unit of function"), in Huxley, who refers to genes as "functional units of physiological action" (Huxley, 1963 : 28), and in Bock and Wahlert ("functional complex," "functional unit," "character complex," Bock and Wahlert, 1965). Bock and Wahlert (1965 : 272) define the functional complex as a character of the organism, which consists of characters of a lower order which operate together for the performance of a given general biological role. Although each organ performs some function, the organism has specialized structures (organs) for the performance of specific functions. We believe therefore that several functional complexes corresponding to the above functions can be established in the Chydoridae. Each functional complex may differ from one species to another. Basically different functional complexes are assigned to different morphofunctional types. An attempt is made to correlate their operation and structure with the biology and behavior of each species. The concept of functional units permits a better understanding of the operation of the organism and the group of sense organs which perform a given function. Each functional unit consists of a performing and a perceiving part.

In addition to the division of functions between different organs, there are cases in which an organ performs several functions. Bock and Wahlert (1965 : 275) state that a character may have several functions simultaneously, usually even if it has only one form. A related concept is that of multifunctionality (Aleev, 1963 : 220; Zuev, 1966 : 45, 109). Movements of legs II and III scrape food and at the same time move the rows of feathered setae which form the filtration chamber and bring food to the mouth. Another example of a combined performance of functions is the operation of the postabdomen. The postabdomen is situated in the pump chamber between the exopodites of legs IV and V and takes part in locomotion (repulsion from the substrate); the postabdomen cleans the exopodites of the legs which form the pump chamber with its lateral setae by moving between the legs; by moving forward, the postabdomen cooperates with leg I in discarding lumps of food from the mouth. The postabdomen obviously takes part in the work of different functional units. Feeding and respiration are morphofunctionally combined in the Chydoridae. The organs which obtain food are also responsible for the oxygen supply; the blood carries both food and oxygen.

Behavior is closely associated with the morphology of these structures which form specific functional complexes. A thorough study of the comparative functional morphology of the Chydoridae was published by Fryer (1968).

FUNCTIONAL COMPLEX RESPONSIBLE FOR SWIMMING

The antennae and their musculature are the performing part of this functional complex. The perceiving part consists of the eye, the ocellus, the tactile setae on the antennae, and, partly, the antennules with the
75 esthetascs. The function of the antennules can be evaluated in terms of their relative size and the frequency of beats during swimming. The length of the rami of the antennae is 9 to 29% of the body length, and that of the feathered distal setae of the antenna 16 to 57% of the body length (Table 1; Dybowski and Grochowski, 1898a). The pelagic Daphniidae have natatorial

antennae of similar size. However, the body of the Chydoridae is more strongly chitinized and therefore much heavier. Moreover, the antennae of the Chydoridae bear only 8 or 7 natatorial setae, compared with 9 in the Daphniidae and at least 15 in the primitive Sididae. The oligomerization of the number of natatorial setae in the Chydoridae is functionally associated with the reduced requirements for swimming in the coastal zone.

TABLE 1. Relative length of the rami of the antennae and their setae as % of the body length (after Dybowski and Grochowski, 1898a)

Species	Exopodite	Endopodite	Setae on third segment of exopodite	Setae on third segment of endopodite
Eurycercus polyodontus	16	14	27	27
Pleuroxus trigonellus	13	13	39	37
P. uncinatus	17	17	52	45
P. truncatus	14	14	39	36
Alonella excisa	23	23	45	42
Pseudochydorus globosus globosus	17	17	58	58
Disparalona rostrata	19	19	33	37
Biapertura affinis	16	14	34	33
Oxyurella tenuicaudis	13	13	34	23
Graptoleberis testudinaria	16	15	41	34
Acroperus harpae	20	19	40	28
Camptocercus rectirostris	12	9	27	23
Monospilus dispar	29	29	57	49
Leydigia leydigi	13	11	19	16

The setae of the third segment of the rami of the antennae are especially well developed in the Chydoridae. The second segment bears a smaller seta, and the seta of the first segment is small or absent. This can be interpreted as a suppression of the proximal by the distal setae. It is interesting that the seta of the first segment is sometimes larger than the others in Macrothrix. In the Chydoridae, the periods of swimming are shorter than the time spent on the substrate. The antennae (like the antennules, legs I, II, III, and IV, the postabdomen, and the mandible) do not perform continuous rhythmic vibrations. During the swimming periods, the antennae of the Chydoridae beat about twice as frequently as those of the Daphniidae.

Frequency of beats of the antennae per minute at 22°C

Eurycercus lamellatus (length 2.2 mm)	360
Pleuroxus aduncus	330
P. truncatus	300
Disparalona rostrata	345
Chydorus sphaericus	406
Ch. gibbus	312
Pseudochydorus globosus	345
Biapertura affinis	252
Monospilus dispar	360
Daphnia magna (after McMahon and Rigler, 1963)	165

The swimming capacity of the Chydoridae is associated with their external form. They have a rounded profile; the ventral side is less convex than the dorsal side even in rounded forms. The ratio of the length to height varies from 1 to 2.26; it is lower in the Chydorinae and higher in the Aloninae (Figure 103). The primitive subfamily Eurycercinae has an intermediate 76 position; its length to height ratios are situated in the zone of overlap of the former two subfamilies. The height to width (thickness) ratios vary from 1 to 1.8 in the Chydorinae. The Aloninae, which have a different phylogenetic direction, have a laterally compressed body with a height to width ratio from 1.7 to 2.26. The males are usually wider than the females. The dorsal or ventral view shows a streamlined figure resembling the cross section of a biconvex lens. Only a few authors have illustrated the anterior view.

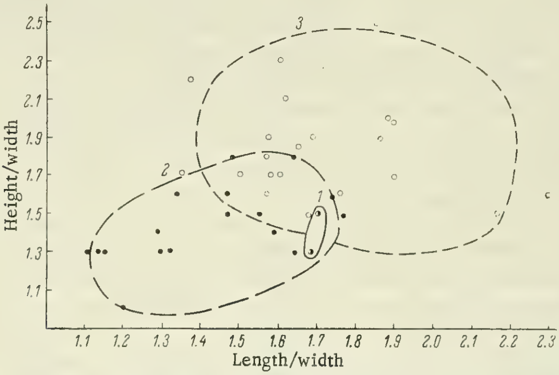

FIGURE 103. Distribution of the length/width and height/width ratios:

1 — Eurycercinae; 2 — Chydorinae; 3 — Aloninae.

The frontal section is generally oval but shows characteristic differences in different biological and taxonomic groups (Figures 104—106). The area of the frontal section is very small compared with the lateral area or with the longitudinal section. This is not surprising, since the animals swim and run forward. The considerable height of the body of the Chydoridae in relation to the length (length to height ratio not greater than 2) is connected with their comparatively low swimming speed. We determined the swimming speed in a tray 5 mm wide and 100 mm long. Most Chydoridae swim at speeds of 2.5 to 7 mm/sec; Monospilus swims slowly at a speed of 0.7 mm/sec, while the swimming speed of the large Eurycercus may be as much as 20 mm/sec (Table 2). The body form of the Chydoridae enables them to squeeze through masses of filamentous algae or particles of detritus.

We determined the rate of sinking after the method of Brooks and Hutchinson (1950) and Yashnov (1952). The experiment was carried out in a jar 15 cm wide with a 30 cm layer of distilled water. The crustaceans were immobilized with dilute hydrochloric acid. The data obtained are given in Table 3.

The table shows that the sinking rate of small Chydoridae is 2 to 3 mm/sec. Large Chydoridae sink more rapidly. The sinking rate of an egg-bearing female of Eurycercus lamellatus is $\frac{1}{4}$ greater than that of an egg-bearing Daphnia longispina of the same size; this difference is mainly due to the stronger chitinization of Eurycercus lamellatus.

Comparison of the rates of sinking (Table 3) and swimming (Table 2) of the Chydoridae shows that swimming is more rapid.

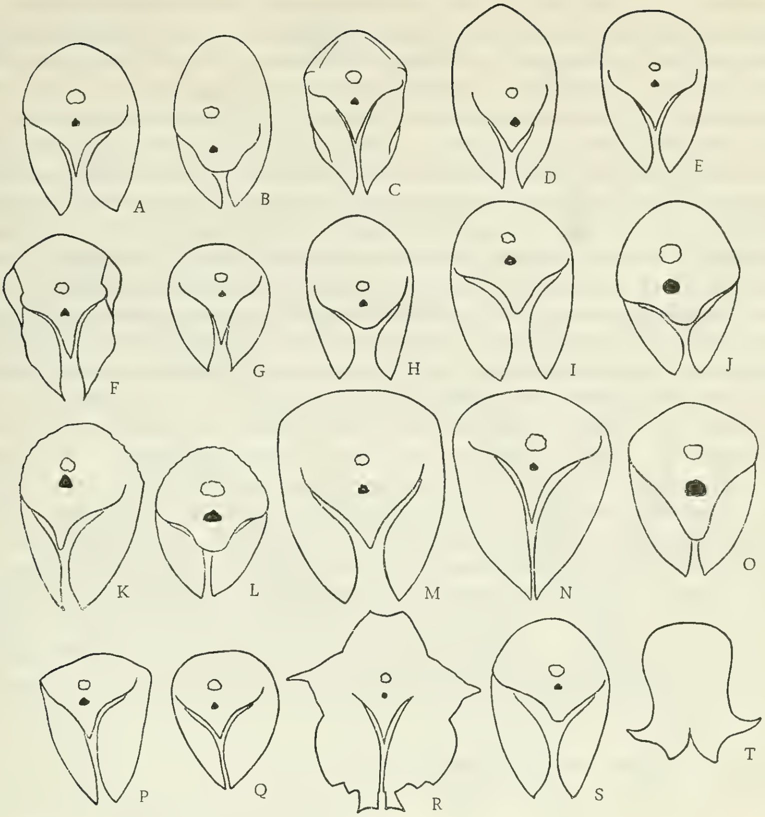

FIGURE 104. Anterior view of Chydorinae:

A — Pleuroxus truncatus, female, height/width 1.5 (Cherepovets Reservoir, 16 September 1963); B — P. truncatus, male, height/width 1.8 (same locality); C — P. trigonellus, female, height/width 1.6 (Rybinsk Reservoir, 24 July 1965); D — P. trigonellus, male, height/width 1.8 (same locality); E — P. aduncus, female, height/width 1.6 (Sutka River, 11 August 1962); F — P. uncinatus, female, height/width 1.4 (Il'd River, 10 August 1962); G — P. striatus, female, height/width 1.3 (Rybinsk Reservoir, 12 July 1962); H — P. letourneuxi, female, height/width ratio 1.3 (Turkey, Florya, March 1939); I — Alonella excisa, female, height/width 1.5 (Rybinsk Reservoir, 3 May 1962); J — A. excisa, male, height/width 1.4 (Rybinsk Reservoir, 2 October 1962); K — Disparalona rostrata, female, height/width 1.6 (Pechora River, 8 August 1963); L — D. rostrata, male, height/width 1.4 (Rybinsk Reservoir, 15 September 1965); M — Chydorus sphaericus, female, height/width 1.3 (Rybinsk Reservoir, 13 June 1931); N — Pseudochydorus globosus, female, height/width 1.3 (Storm King Dam, Queensland, Australia, 9 November 1964); O — Chydorus gibbus, male, height/width 1.3 (Rybinsk Reservoir, 30 September 1965); P — Ch. gibbus, female, height/width 1.8 (Rybinsk Reservoir, 15 September 1965); Q — Ch. barroisi, female, height/width 1.3 (Borumba Dam, Australia, 16 February 1965); R — Ch. bicornutus, female, height/width 1.05 (including the keels, after Doolittle, 1911); S — Dunhevedia crassa, female, height/width 1.5 (Storm King Dam, Queensland, Australia, 9 November 1964); T — Pleuroxus pamirensis, female, height/width 1.06 (including the keels, after Vereshchagin, 1923).

The Eurycercinae, Sayciinae, and Aloninae have a vertical keel which ranges from barely visible to strongly developed. Some species of Acroperus and Camptocercus have a well developed vertical keel in the form of a large transparent comb. This keel is apparently a defensive formation because the worm Chaetogaster diaphanus Gruith. is almost unable to catch Acroperus harpae while it consumes numerous juvenile Eurycercus of similar size but without a keel (Green, 1954). The Chydorinae have no vertical keels, but lateral keels may be present in some species of Pleuroxus and Chydorus (Figure 104). The height to width ratio of these forms, which are wide in any case, attains 1.05. In contrast to the swimming forms, the maximum width of benthic Chydoridae is above midheight (especially in Monospilus dispar, Chydorus
78 gibbus, and Pleuroxus uncinatus); moreover, benthic species have a rugose or ribbed surface (P. uncinatus and Disparalona rostrata, Figure 104) and retain molted valves (Monospilus dispar, Acroperus elongatus, and Rhynchotalona falcata). All the head pores of the wide forms are situated close to the median vertical plane. The subfamily Aloninae has cases in which the lateral pores are situated close to the main pores or distant from them. Vital staining shows cavities associated with the main pores in all Chydoridae and also canals at the lateral pores in Eurycercus and the Aloninae. The development of the keels was possible only in groups in which the small pores are situated far from the median line (cf., Acroperus elongatus and A. harpae). In the keeled species of Camptocercus, the small pores are situated far from the main ones. There are no keels in groups of Chydoridae in which the small pores are situated close to the median line.

TABLE 2. Swimming speeds of Chydoridae, mm/sec

Species	t, °C	Average speed	Maximum speed
Biapertura affinis, adult females	16	5	7
Chydorus sphaericus, adult females	16	7	9
Eurycercus lamellatus, female, 2 mm long	16	17	20
Disparalona rostrata, adult females with embryos	15	2.5	3.2
D. rostrata, ephippial females	15	2.6	3
D. rostrata, adult males	15	2.4	2.5
Chydorus gibbus, adult females with embryos	15	5	6
Rhynchotalona falcata, ephippial females . .	15	2.5	3
Monospilus dispar, adult females	15	0.7	0.7
Acroperus elongatus, ephippial females	18	5	7

80 Although the Chydoridae can move on the substrate in any position, they swim with the dorsal side either up or down. Euryalona orientalis, Leydigiopsis curvirostris (Sars, 1901), Leydigia australis (Sars, 1886), and Alona costata swim with the dorsal side down. Chydorus sphaericus swims with the head up and the ventral side forward. Young females of Eurycercus lamellatus swim with the dorsal side up. Large adult gravid females of E. lamellatus swim with the head up

because of the changed position of the center of gravity. They move with the dorsal side forward. E. lamellatus begins to swim after being disturbed with a needle, but only for a short time, from 1 to 100 sec, usually less than a minute. They usually rest in the corners between the walls and bottom (in experiments without silt). The average number of stops in the corners was over 70% of the total number of stops. Dunhevedia serrata swims in jerks (Fryer, 1957). The relative length of the rami of the antennae and distal setae of Camptocercus rectirostris is less than in other Chydoridae (Table 1) because of the considerable length of the body. This is compensated by the long postabdomen, which is responsible for repulsion and causes the jerky movement. Eurycercus lamellatus sinks rapidly to the bottom when a resting culture is disturbed. Many Chydoridae react to contact by stopping their movements and sinking to the bottom, where they remain immobile for several seconds; they then resume swimming (for example, Disparalona rostrata, male and female).

(78)

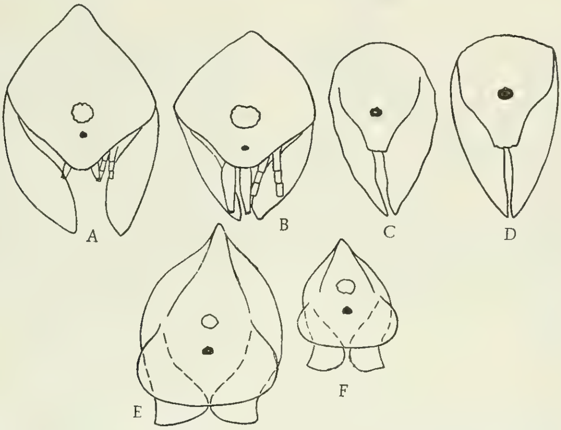

FIGURE 105. Anterior view. Males and females not drawn to the same scale:

A — Eurycercus lamellatus, female, height/width 1.5, length 2.4 mm (Cherepovets Reservoir, 20 October 1963); B — E. lamellatus, male, height/width 1.3, length 1.0 mm (same locality); C, D — Monospilus dispar, female and male, height/width 1.7 (Rybinsk Reservoir, 15 September 1965); E, F — Graptoleberis testudinaria, female, height/width 1.6 (Cherepovets Reservoir, 16 September 1963).

The sense organs of the Chydoridae are markedly modified due to their living close to the shore and on the bottom. The reduction in the number of facets in the Chydorinae and Aloninae compared with the primitive Eurycercus reflects the lesser importance of a differentiated perception of form in a turbid coastal and benthic environment. The pigment spot is larger than the eye in benthic forms such as Chydorus gibbus, Rhynchotalona falcata, and Leydigia. The benthic Monospilus dispar has only one pigment spot. In relation to body size, the eye and the pigment spot are larger in males than in females (Figure 105). Dadaya macrops, which lives at the surface, has an unusual development of eye and ocellus (Figure 72).

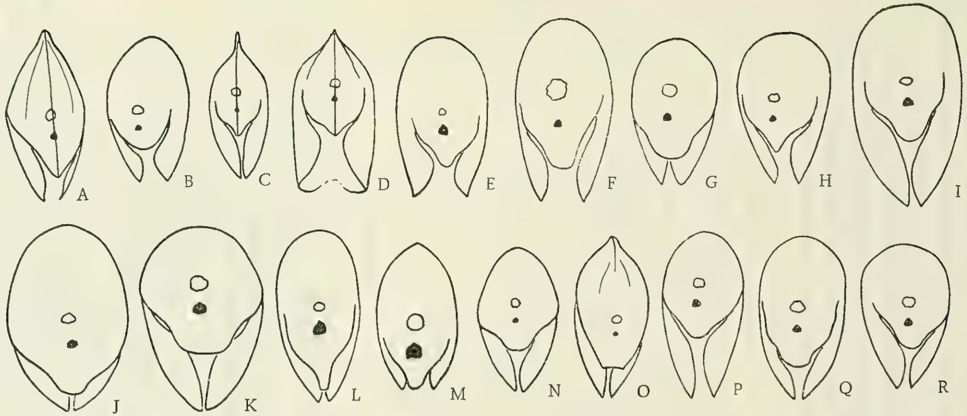

FIGURE 106. Anterior view of Aloninae:

A — *Acroperus harpae*, female, height/width 2.3 (Rybinsk Reservoir, 13 June 1961); B — *A. elongatus*, female, height/width 1.9 (Lake Seito, Arkhangelsk Region, 12 August 1961); C — *Camptocercus lilljeborgi*, female, height/width 2.5 (Sutka River, 11 August 1962); D — *C. rectirostris*, female, height/width 2.0 (Rybinsk Reservoir, 13 September 1961); E — *Leydigia leydigi*, female, height/width 1.7 (Ladka River, 14 August 1962); F — *Alona costata*, female, height/width 1.9 (Rybinsk Reservoir, 13 June 1961); G — *A. costata*, male, height/width 1.7 (same locality); H — *Biapertura karua*, female, height/width 1.6 (University Pond, Brisbane, Australia); I — *Oxyurella tenuicaudis*, female, height/width 1.85 (Ivan'kovo Reservoir, 21 July 1962); J — *Biapertura affinis*, female; K — *B. affinis*, male, height/width 1.5 (Rybinsk Reservoir, 2 October 1962); L — *Rhynchotalona falcata*, female, height/width 2.0 (Uglich Reservoir, 23 July 1962); M — *Rh. falcata*, male, height/width 1.8 (Rybinsk Reservoir, 30 September 1965); N — *Tretocephala ambigua*, female, height/width 1.8 (Mashikhanskii pond, Lenkoran' district, 25 May 1963); O — *Alona davidi*, female, height/width 2.2 (Storm King Dam, Queensland, Australia, 9 November 1964); P — *A. guttata*, female, height/width 2.1 (Lake Seito, Arkhangelsk Region, 12 August 1961); Q — *A. quadrangularis*, female, height/width 1.9 (Ladka River, 14 August 1962); R — *A. rectangula*, female, height/width 1.7 (Pechora River, 8 August 1963).

TABLE 3. Average sinking rate of immobilized female Cladocera, females with embryos, mm/sec at 17°C

Species	Length, mm	Sinking rate	Sinking rate as percentage of body length
Chydorus sphaericus	0.4	2	500
Pleuroxus aduncus	0.6	3.3	550
Alona quadrangularis	0.7	2.7	385
Eurycercus lamellatus (without embryos)	0.8	2.8	350
E. lamellatus (without embryos)	1.4	6.4	457
E. lamellatus	2	10	500
E. lamellatus	2.4	13	543
Ceriodaphnia quadrangula	1	2.5	250
Daphnia longispina	2	7.8	390
Simocephalus vetulus	2	8.6	430
Sida crystallina	2.5	11.8	472

There are some data on the effect of light on the movement of Chydoridae. Chydoridae, including the benthic Monospilus, Rhynchotalona, Chydorus gibbus, and Pleuroxus uncinatus are positively phototactic. P. truncatus is attracted mainly by the blue of the sky and blue parts of the spectrum and reacts positively to ultraviolet light (Peters, 1927). When illuminated from above, Pseudochydorus globosus and Kurzia latissima move downward when the color changes from yellow to white, and upward when the light changes from blue to white (Smith and Baylor, 1953). Pseudochydorus globosus and Kurzia latissima move at right angles to the plane of polarization in polarized light (Baylor and Smith, 1953).

FUNCTIONAL COMPLEX RESPONSIBLE FOR MOVEMENT ON THE SUBSTRATE

The specialization of Chydoridae for life on the substrate (in the littoral) has resulted not only in the development of a functional complex responsible for movement on the substrate but also in a marked modification of the form of the body and of the morphology and performance of structures for obtaining food and for other activities.

81 The functional complex responsible for attachment and movement on the substrate consists of the outer ramus of the endite of leg I, the postabdomen (performing part), the exopodite of leg I (Figures 107–127), the antennules with their esthetascs (perceiving part), and the corresponding muscles. The postabdomen and antennules also take part in obtaining food.

The ability of the Chydoridae to move between particles of silt, overgrowths, filamentous algae, etc., is mainly due to their small frontal section. Some forms move on the surface of the silt or on one side (Alona quadrangularis).

The bottom sediments are not a fine homogeneous suspension but consist mainly of lumps, most of them feces. Filamentous algae are a favorite substrate of the Chydoridae, as is the surface of macrophytes. Acroperus harpae settles on detritus particles, on threadlike remains of macrophytes, and especially on filamentous algae covered with epiphytes (on Oedogonium, Vaucheria); it also feeds on the surface of particles of feces. Chydorus sphaericus remains for a long time on dead Cladocera covered with bacteria. The Chydoridae may remain suspended on the surface (with the dorsal side down) on which they move, e.g., Pleuroxus truncatus, P. striatus, and Disparalona rostrata. Dadaya macrops is specialized for feeding below the surface and can suspend itself on it (Fryer, 1956; Lochhead, 1961). The ventral margin of this species is darker than the dorsal margin.

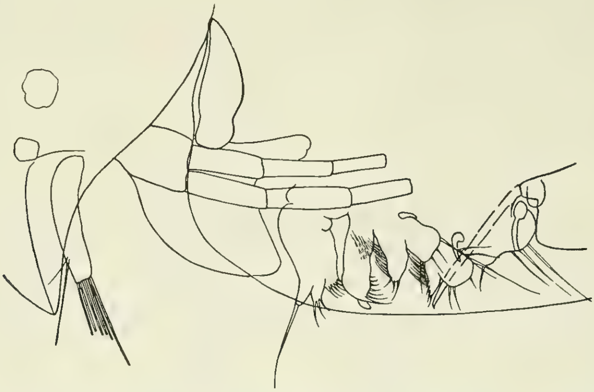

FIGURE 107. Relative position of the appendages of Acroperus harpae

When Acroperus harpae and Camptocercus are situated on the substrate, their antennae are directed down and posteriorly so that the setae of the exopodite extend along the sides of the valves toward the posteroventral corner of the valve; the setae of the endopodite are situated slightly higher. The antennae of the running Pseudochydorus globosus are immobile, directed downward, and withdrawn under the valve. The antennules of this species move only rarely while the animal moves.

Eurycercus lamellatus, Disparalona rostrata, Acroperus harpae, and Biapertura affinis move with the ventral side toward the substrate. Chydoridae may feed on one side and in other positions as well. If the particle is large, the crustacean moves on it with legs I, pushing off with the postabdomen. If the particle is small, the animal rotates it with the base of the claws (situated behind leg II) while the postabdomen makes small jerks. It feeds on the surface of the food particle, which it holds and rotates. Acroperus harpae moves rapidly through filamentous algae by jerky movements of the postabdomen. When resting on a filament, A. harpae holds it with the setae of legs I so that the filament is situated partly between the valves and between the legs. The valve does not press on the filament. The crustacean moves along the filament or in a spiral, using the hard setae on the endite of leg II to remove diatoms. On reaching the end of the filament, the crustacean moves the antennae, turns around, and goes back along the filament, feeding constantly. The animal does not leave the filament during the turn. It passes around a detritus

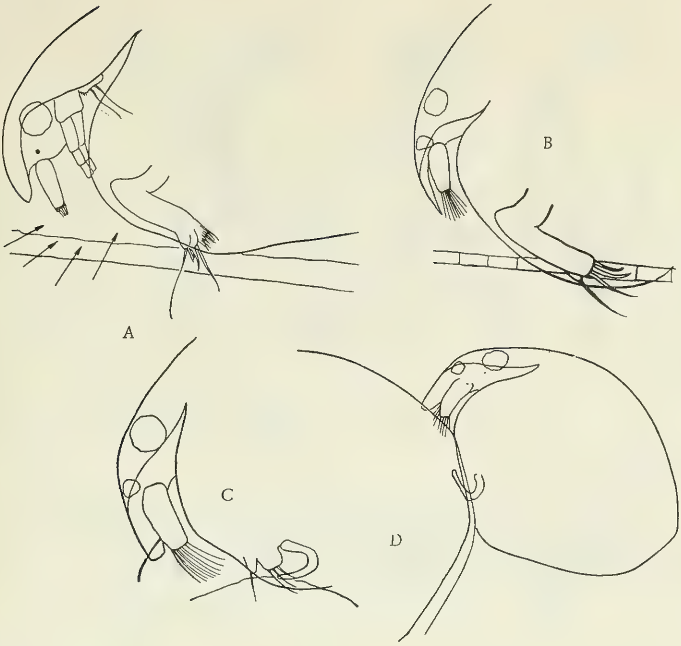

FIGURE 108.

A — anterior end of a female of Eurycercus lamellatus on the substrate; B — anterior end of a female of Chydorus sphaericus on the substrate; C — anterior end of a male of Ch. sphaericus on the substrate; D—male of Ch. sphaericus, attached to valve of a female (Rybinsk Reservoir, October 1965).

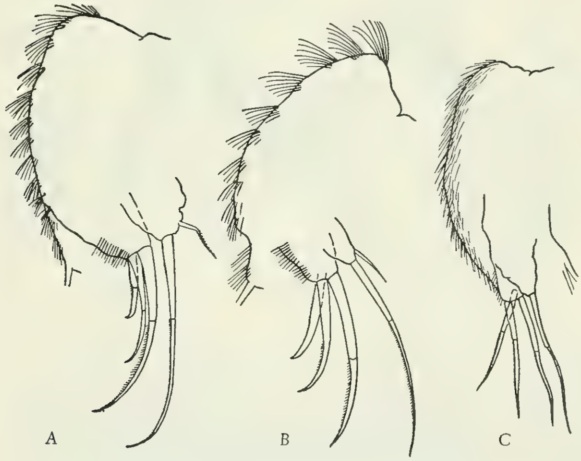

FIGURE 109. Outer ramus of endite and exopodite of females:

A — Eurycercus glacialis (left side, Holland); B — E. lamellatus; C — Saycia cooki (Australia). (Legs I are shown in Figures 109—127.)

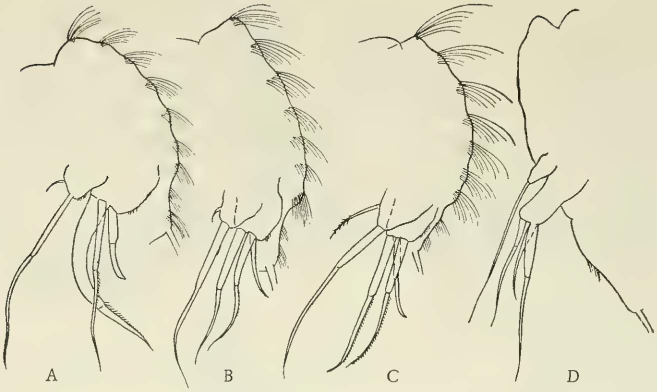

FIGURE 110. Outer ramus of endite and exopodite of female of Pleuroxus (right side, outer view):

A — P. aduncus aduncus (Il'd River, 10 August 1962); B — P. letourneuxi (Turkey); C — P. trigonellus trigonellus (Cherepovets Reservoir, 8 August 1963); D — Dadaya macrops (Gayndah, Queensland, Australia, 29 October 1964). (Not drawn to scale.)

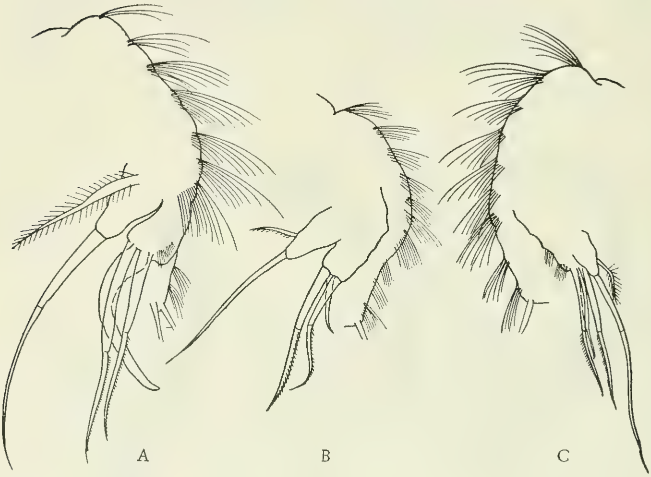

FIGURE 111. Outer ramus of endite and exopodite of female of Pleuroxus:

A — P. truncatus (right side, outer view; Rybinsk Reservoir, 18 September 1962); B — P. striatus (right side, outer view; Rybinsk Reservoir, 12 July 1962); C — P. uncinatus (left side, outer view; Il'd River, 10 August 1962).

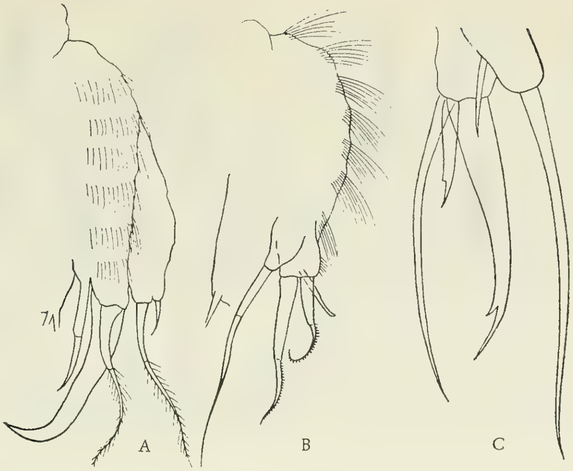

FIGURE 112. Outer ramus of endite and exopodite of females:

A — Pleuroxus hamatus hamatus (after Brooks, 1959); B — P. similis (right side, outer view; Lake Issyk-Kul', 10 August 1964); C — P. hamatus vulcanicus (after Brehm, 1951a).

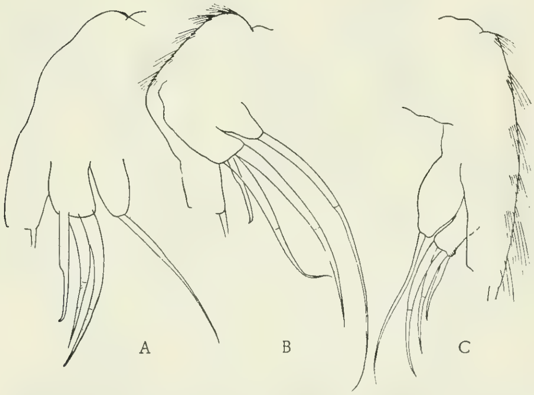

FIGURE 113. Outer ramus of endite and exopodite of females:

A — Alonella excisa excisa (left side, outer view; Rybinsk Reservoir, 3 May 1962); B — Disparalona rostrata rostrata (left side, outer view; Uglich Reservoir, 23 July 1962); C — Chydorus brevidentatus (White Nile, 19 April 1964).

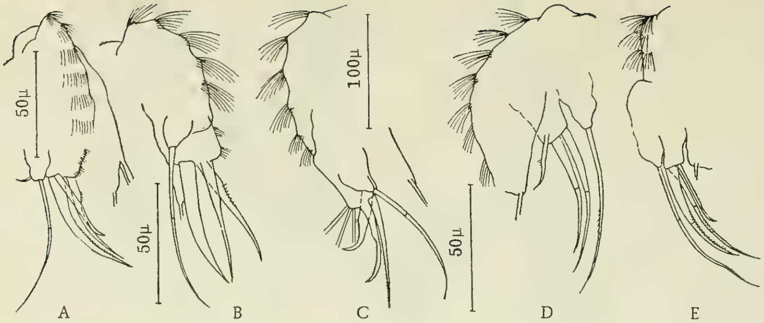

FIGURE 114. Outer ramus of endite and exopodite of females:

A — Chydorus sphaericus; B — Ch. eurynotus; C — Pseudochydorus globosus; D — Chydorus barroisi; E — Ch. gibbus.

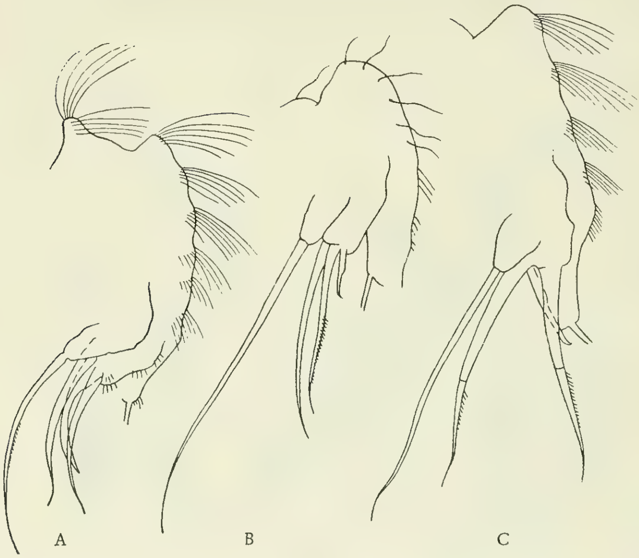

FIGURE 115. Outer ramus of endite and exopodite of females (right side, outer view):

A — Biapertura affinis (Shumarovka River, 2 August 1962); B — Alona quadrangularis (Ladka River, 14 August 1962); C — A. cambouei (Minindie Lakes, New South Wales, Australia, 29 September 1961).

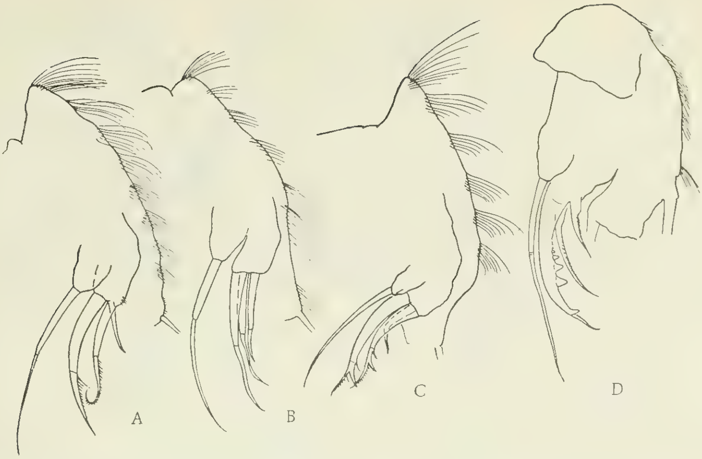

FIGURE 116. Outer ramus of endite and exopodite of females (right side, outer view):

A — Tretocephala ambigua (Lenkoran' district, 26 May 1963); B — Oxyurella tenuicaudis (Ivan'kovo Reservoir, 21 July 1962); C — Kurzia longirostris (Lake Djor, White Nile, 8 February 1964); D — Euryalona orientalis (left leg, posterior view; White Nile, Um-Arda, 11 April 1964).

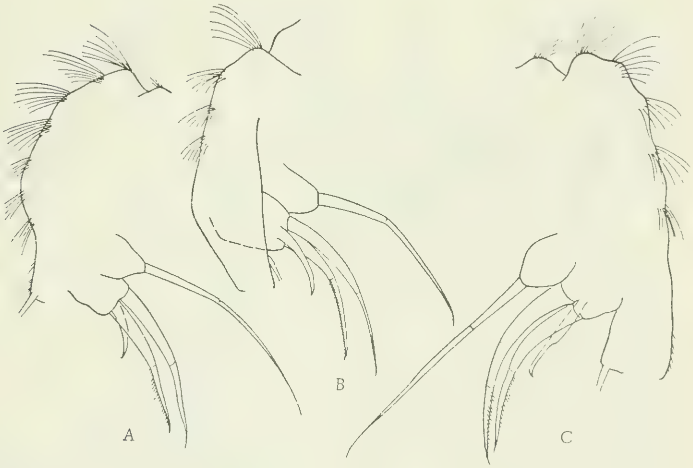

FIGURE 117. Outer ramus of endite and exopodite of female of Acroperus:

A — A. alonoides (left side, outer view; Cherepovets Reservoir, 16 September 1962); B — A. elongatus (right leg, inner view; Uglich Reservoir, 23 July 1962); C — A. harpae (right leg, anterior view; Rybinsk Reservoir, 13 June 1961).

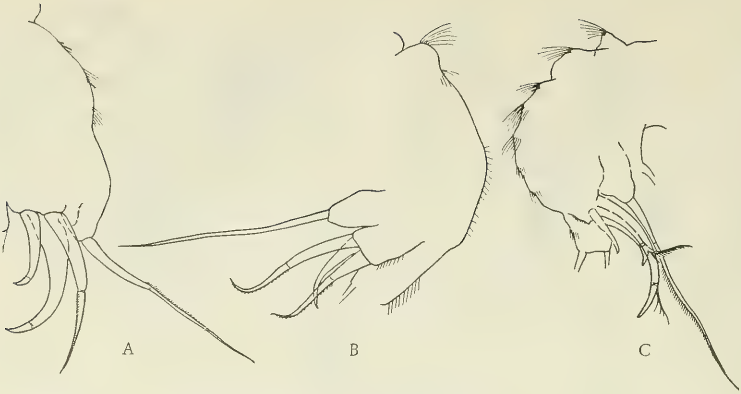

FIGURE 118. Outer ramus of endite and exopodite of female Camptocercus:

A — C. rectirostris (left leg, inner view; Rybinsk Reservoir, 13 September 1961); B — C. lilljeborgi (right leg, outer view; Sutka River, 11 August 1962); C — C. uncinatus (right leg, inner view, female; White Nile, Um-Arda, 11 April 1964).

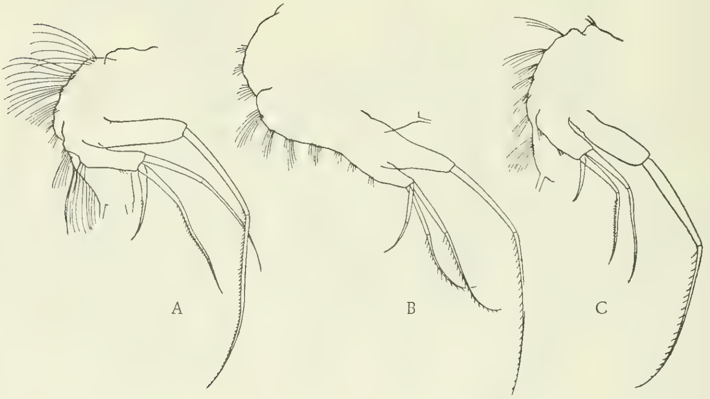

FIGURE 119. Outer ramus of endite and exopodite of females:

A — Leydigia ciliata (left leg, outer view; Lake Karmak-Kul', Aktyubinsk Region, 15 August 1965); B — L. australis (after Sars, 1886); C — L. leydigi (left leg, outer view; Ladka River, 14 August 1962).

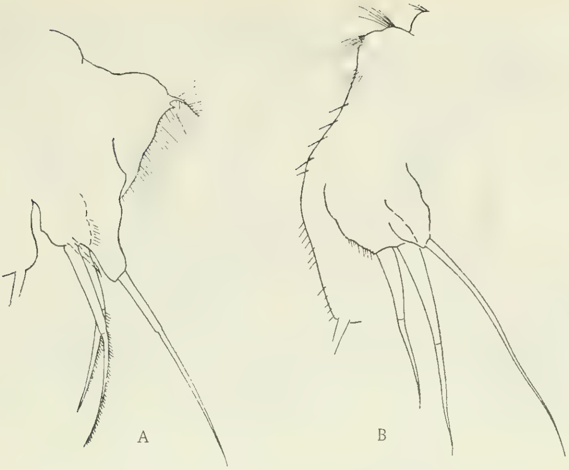

FIGURE 120. Outer ramus of endite and exopodite of females:

A — Graptoleberis testudinaria (right leg, outer view; Cherepovets Reservoir, 16 September 1963); B — Monospilus dispar (left leg, outer view).

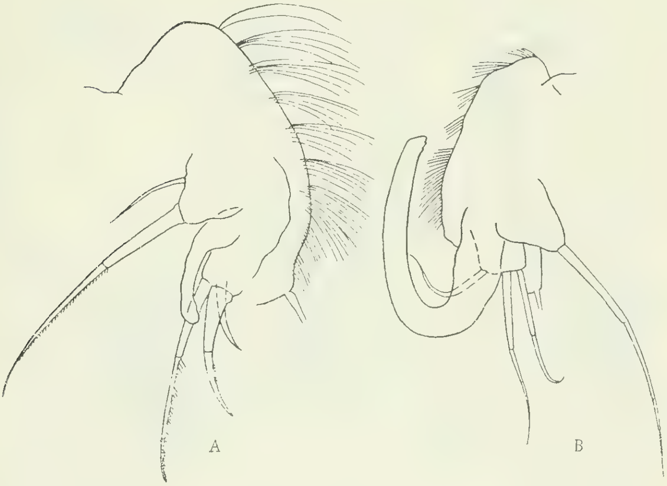

FIGURE 121. Outer ramus of endite and exopodite of males:

A — Eurycercus lamellatus (left leg, outer view; Rybinsk Reservoir, 2 October 1962); B — Disparalona rostrata rostrata (left leg, outer view; Rybinsk Reservoir, 15 September 1965).

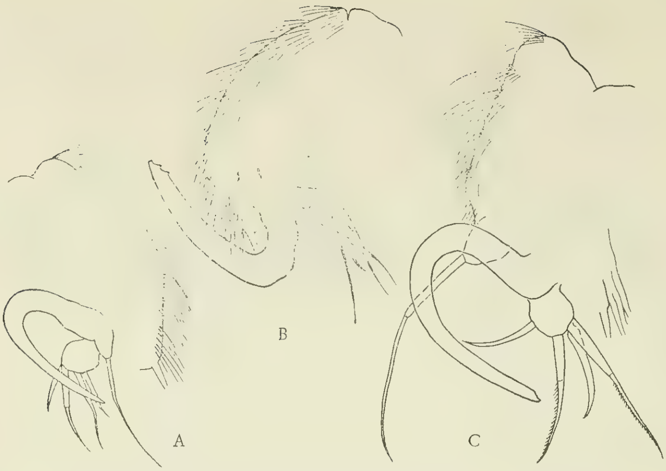

FIGURE 122. Outer ramus of endite and exopodite of male of Pleuroxus:

A — P. trigonellus trigonellus (left leg, outer view; Rybinsk Reservoir, 24 July 1965); B — P. aduncus aduncus (left leg, outer view; Rybinsk Reservoir, culture); C — P. truncatus truncatus (left leg; Rybinsk Reservoir, 18 September 1962).

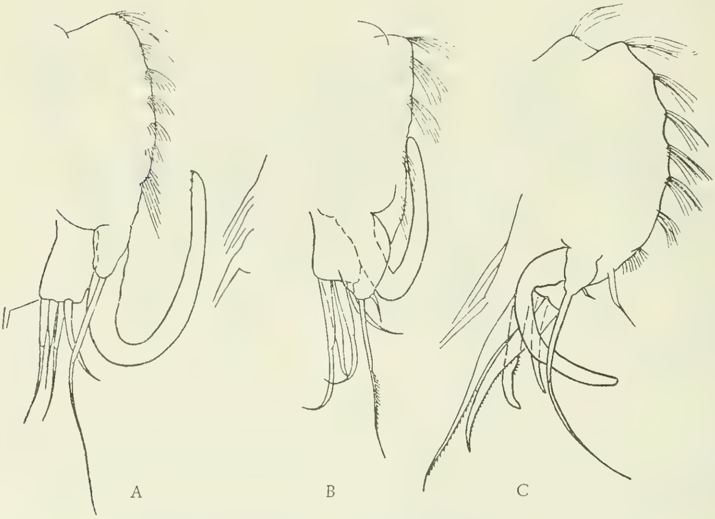

FIGURE 123. Outer ramus of endite and exopodite of males:

A — Chydorus sphaericus; B — Ch. gibbus; C — Pseudochydorus globosus globosus. A, B — Rybinsk Reservoir; C — Cherepovets Reservoir.

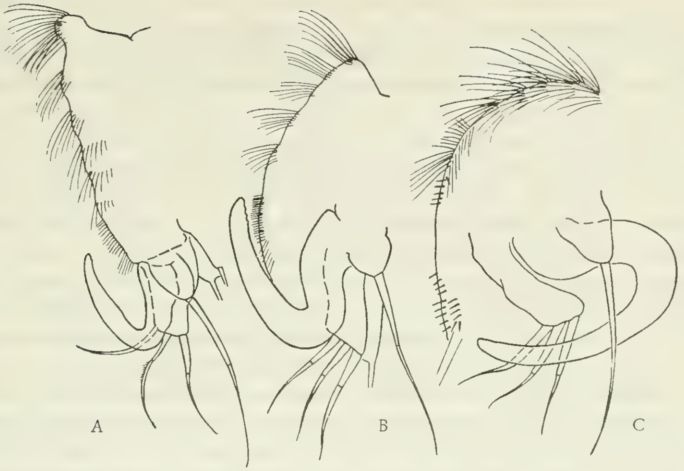

FIGURE 124. Outer ramus of endite and exopodite of males (left leg, outer view):

A — Tretocephala ambigua (Lenkoran' District); B — Alona costata (Cherepovets Reservoir, 21 October 1963); C — Biapertura affinis (Rybinsk Reservoir, 18 September 1962).

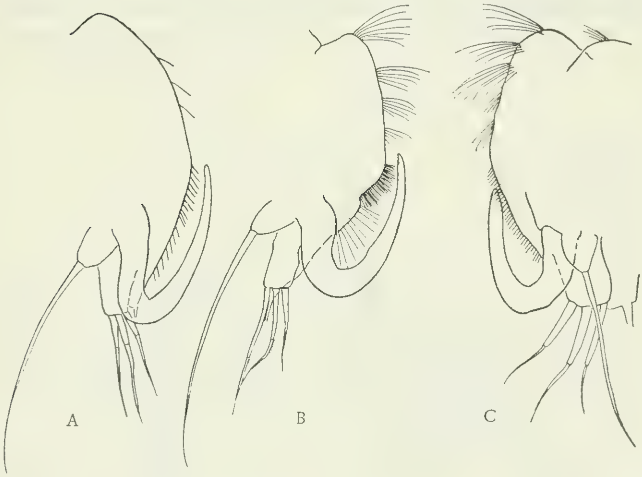

FIGURE 125. Outer ramus of endite and exopodite of males:

A — Acroperus alonoides (right leg, outer view; Cherepovets Reservoir); B — A. elongatus; C — Alona rectangula rectangula (left leg, outer view; Lake Issyk-Kul', 12 October 1965).

particle. A. harpae does not remain long on a cellulose fiber but runs along it and swims away.

91 The Chydoridae pass from one substrate to another in search of food. After finding a suitable substrate, they remain for a long time and feed. A similar observation was reported by Sars (1886) for Leydigia australis.

It was found that the swimming periods of the Chydoridae are much shorter than the time spent on the substrate.

The outer ramus of the endite of leg I bears strongly chitinized setae, while the exopodite bears thin tactile setae.

The outer ramus of the endite and the exopodite are separated by deep grooves from the leg so that they appear as distinct segments. Each of these parts of leg I has a musculature and is independently mobile.

The outer ramus of the endite of females bears three setae of different length. Three setae are apparently the minimum necessary for fixation on the substrate. The inner seta is shorter than the others, hook-shaped, and grasps the substrate. The other two setae are of slightly different length; they are unilaterally feathered (brushlike) and hold the substrate. The anterior seta is slightly shorter than the posterior, which corresponds to the spatial relationships with the ventral margin of the valve. Thus, leg I (including the outer ramus of the endite) is situated obliquely to the ventral margin of the valve, and the distance from the ventral margin of the posterior side of the endite to the margin of the valve is shorter than the distance from the dorsal margin of the posterior side of the endite to the valve margin. Observations on Pleuroxus uncinatus and Acroperus harpae have shown that the animal uses the three setae on the outer ramus of the endite for holding the substrate. In this position, the seta of the exopodite is taken out from under the valve and directed anteroventrally.

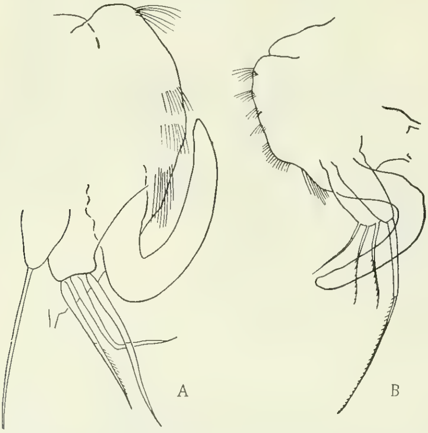

FIGURE 126. Outer ramus of endite and exopodite of males:

A — Rhynchotalona falcata (right leg, left side; Rybinsk Reservoir, 30 September 1965); B — Leydigia australis (after Sars, 1886).

Most Chydoridae feed on a convex substrate (detritus particles, filamentous algae). In this case the inner ambulacral seta should be shorter than the others, since the detritus particle is situated between the legs. This is in fact the case. The hook-shaped seta is short in females of Disparalona rostrata, Alona quadrangularis, Acroperus, and Leydigia, which live among particles of silt and feed on detritus. In contrast, the hook-shaped seta is large and only slightly shorter than the others in the female Pleuroxus truncatus, Alonella excisa, and Biapertura affinis, which live on plants.

An enlargement of the inner hook-shaped seta is found also in the Aloninae.

The form and position of the outer ramus of the endite and the exopodite are modified in some Chydoridae. In Leydigia which lives on silt, the exopodite and the outer ramus of the endite are very long and well differentiated from the base of the endite. The tactile seta of the exopodite is very long. In Dadaya macrops, which feeds on the surface, these parts of leg I are small and situated in the middle of the endite, probably because of the type of substrate. A characteristic modification of the structures which form this functional complex is present in Graptoleberis testudinaria. The inner of the three setae on the outer ramus of the endite of leg I is very
92 short, the other two are long and of about the same length. The contact with a flat substrate is also responsible for the development of a setiform appendage in the proximal part of the anterior surface of the endite of leg I. The ventral side appears as a flat sole formed by the wide rostrum and the extended anterior part of the ventral side of the valves.

The exopodite of Eurycercus and Pleuroxus bears a long tactile seta and a short seta. Observations have shown that the long seta feels the substrate some distance from the animal. The short seta may have a tactile function at close range (in Pleuroxus truncatus); another possible function is tactile perception of the position of the exopodite with respect to leg I or other parts of the body.

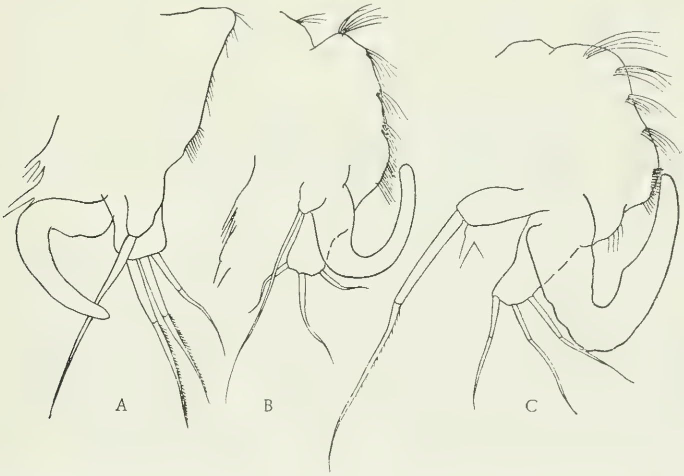

FIGURE 127. Outer ramus of endite and exopodite of males (right leg, outer view):

A — Graptoleberis testudinaria (Cherepovets Reservoir, 16 September 1963); B — Monospilus dispar (Rybinsk Reservoir, 30 September 1963); C — Leydigia leydigi (Ladka River, 14 August 1962).

In Alonella, Dunhevedia, Dadaya, and in the Aloninae the exopodite bears one long seta which is directed anteroventrally; it moves with the exopodite separately from the other part of leg I and feels the substrate.

The distal papillae of the antennules are directed ventrolaterally. They may be almost equal or markedly different in length (Acroperus, Camptocercus), permitting perception at different distances.

The structures of this functional complex in the male differ from those of the female in most species (Figures 121–127).

The outer ramus of the endite of the male Eurycercus and of the Aloninae bears three setae, that of Pleuroxus four. In Eurycercus, one of the three setae is hook-shaped and much smaller than the others. Two of the four setae in Pleuroxus are short and hook-shaped. In the male Aloninae and in Disparalona rostrata rostrata, all setae are of equal length. The males differ markedly from the females in this respect, viz., one of the setae is hook-shaped and much shorter than the others.

All male Cladocera have a chitinized hook on the base of the outer ramus of the endite of leg I which serves for attachment to the valve of the female. Contrary to the view of Herrick (1884), the hook on the endite of leg I of the males is not a modification of a seta, but probably developed from one of the tubercles on the outer ramus of the endite.

The setae on the outer ramus of the endite of leg I vary in form from thin setae with unilateral setules in the distal part to thick hooks without setules. Comparison of homologous setae of different species shows that
93 the hook-shaped setae develop from one of the basal setae, which grows markedly in size, while the distal part of the seta with the other setules disappears (Figures 128 and 129).

The most primitive structures of this functional complex are found in Saycia cooki, where both the exopodite and the outer ramus of the endite bear setae of equal length and form. This functional complex is of uniform structure in the Eurycercinae, Chydorinae, and Aloninae; it has a similar structure in many Macrothricidae.

Leg I of the Chydoridae resembles leg I of the Daphniidae but not that of the Sididae.

Comparison of leg I of Daphnia pulex (De Geer) and Pleuroxus aduncus shows that the main difference between them is the presence of three strongly chitinized setae on the outer ramus of the endite in the Chydoridae; the setae of the inner ramus of the endite are short but the stem of the endite is large. The muscles of leg I of the Chydoridae are large and specialized for moving different parts of the leg.

According to Lilljeborg (1900), leg I of Daphnia pulex bears eversible hooks which are also characteristic for the Chydoridae; the exopodite has a long and a short seta, the outer ramus of the endite has 2 setae, the inner (lobed) ramus of the endite has 8 feathered setae, and the inner side of the inner ramus of the endite has 2 setae. In Daphnia longispina O.F. Müller (D. variabilis Langhans), Lityński (1916) found 2 setae on the outer ramus and 10 setae on the inner ramus of the endite. In the Daphniidae, leg I moves together with the other legs; its movements are restricted.

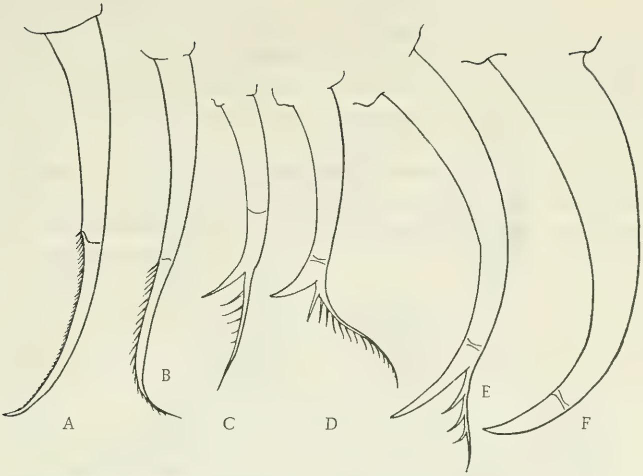

FIGURE 128. Setae on outer ramus of endite of leg I showing the development of the hook-shaped setae:

A — seta 2 of Eurycercus glacialis; B — seta 3 of Camptocercus lilljeborgi; C — seta 3 of Alona rectangula novae-zelandiae; D — seta 2 of Camptocercus uncinatus; E — seta 3 of C. uncinatus; F — seta 2 of C. rectirostris.

The postabdomen of the Chydoridae is well developed, relatively long and bent under the body. The postabdomen of Eurycercus forms a continuation of the body, as in the Daphniidae and Sididae; it contains the intestine and blood. In the more specialized forms (and the majority of the Chydoridae are specialized forms), the anus is situated in the proximal (functionally lower) part of the postabdomen, and blood does not circulate in the postabdomen. In Dunhevedia, the anus is displaced toward the functionally posterior side of the postabdomen. The postabdomen does not form the posterior end of the body here but becomes a specialized appendage. Instead of being a continuation of the body, the postabdomen forms a lateral process at the posterior end of the body.

The ratio between body length and the length of the postabdomen of the Chydoridae varies from 1.9 to 3.8 (usually 2.0—3.4; Figure 130). This explains the uniform function of the postabdomen as a lever in different species of Chydoridae. The subfamilies Chydorinae and Aloninae do not
94 differ much from one another in this respect.

The postabdomen of the Chydoridae takes part in the movement on the substrate and in obtaining food. Its repulsion causes a rotation of the food particle if it is small, or moves the body on large substrates.

The postabdomen can be bent downward, downward and posteriorly, move forward between the legs (by bending the posterior end of the abdomen), and then make a pushing-off movement downward and posteriorly; this was observed in live specimens of Eurycercus lamellatus, Pleuroxus striatus, P. trigonellus, and Graptoleberis testudinaria.

Repulsion by the postabdomen begins when repeated movement of legs I is insufficient for movement. In extreme cases, when the crustacean is holding onto something (or adheres to the surface film) the postabdomen makes abrupt jerks and is extended so that the apex of the claw points posteriorly.

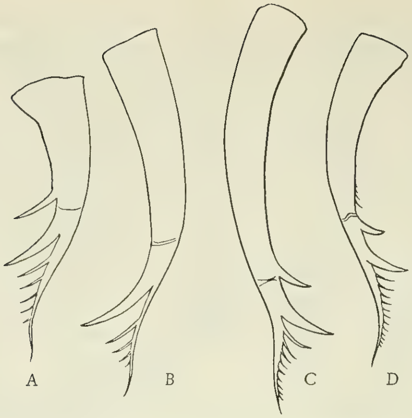

FIGURE 129. Setae on the outer ramus of the endite of leg I:

Alona rectangula (Il'd River, 10 August 1962): A — seta 2, B — seta 3; Kurzia longirostris (Lake Djor, White Nile, 8 February 1964): C — seta 3, D — seta 2.

If there is an obstacle, the forward movement and the wide downward-backward movement of the postabdomen may be accompanied by a lateral bending of the postabdomen because of the asymmetrical action of the muscles of the right and left side (Pleuroxus trigonellus, and P. truncatus). This can easily be observed if the crustacean is placed in a small drop of water on a glass slide. This lateral bend takes place when the postabdomen finds no support for repulsion. Bending of the postabdomen away from the median vertical plane finds the necessary support (the surface of the glass in this case) and pushes off to escape. The main movements of the postabdomen of Acroperus harpae (Figure 131) are as follows: 1) a forward movement in which the postabdomen bends slightly toward the abdomen and moves forward (because of the bending of the posterior part of the abdomen) followed by a brushing movement for the removal of particles which interfere with the action of leg II and for the removal of particles from the mouth; 2) a downward repulsion for the removal of excessively large food particles, for the ejection of feces, and for repulsion from the substrate during movement; 3) a downward-backward movement for escaping from entanglement in filamentous algae or the surface film, etc. Camptocercus lilljeborgi uses its postabdomen for pushing away obstacles and predators and for cleaning the food groove between the legs and the outer surface of the valves (Green, 1956). In contrast to Acroperus, the postabdomen of Camptocercus lilljeborgi can move upward and posteriorly outside the valves (Figure 132). According to Green (1956), this movement is made by rapid contraction and relaxation of longitudinal muscles together with rotation of the postabdomen about its longitudinal axis, caused by the different pull of the muscles of the right and left side. We found similar movements of the postabdomen in C. rectirostris. The postabdomen of Daphnia longispina longispina O.F. Müller makes restricted movements as follows: 1) bending toward the body with a subsequent brushing movement (ejection of an interfering particle); 2) brushing without bending (for the same purpose); 3) bending toward the body with a simultaneous forward movement caused by bending of the abdominal part and the posterior part of the thorax, then a brushing movement which brings the claws to leg I (cleaning of legs). The movements of the postabdomen of the Daphniidae 95 are restricted by the shortness of the postabdomen and abdomen. The musculature of the Daphniidae was described by Binder (1931).

The structural adaptations of the postabdomen for a more effective repulsion from the substrate include enlargement of the distal anal denticles, widening of the distal end of the postabdomen in some species, and lengthening of the distal-dorsal corner of the postabdomen in the older age groups of some species of Chydoridae.

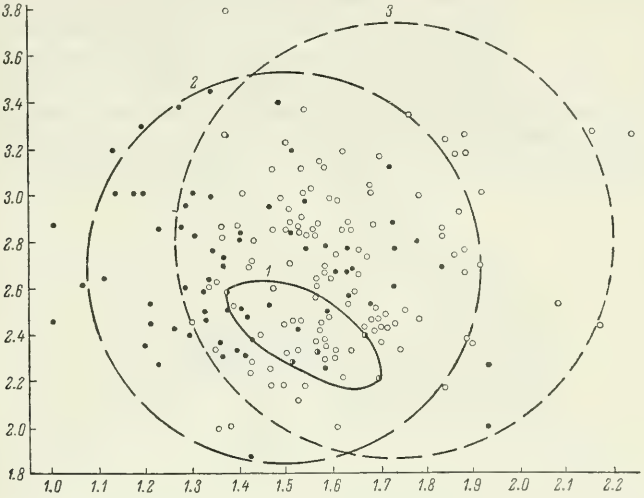

FIGURE 130. Distribution of the ratio of length to height (abscissa) and of the ratio of body length to postabdominal length (ordinate). Data are given for both sexes:

1 — Eurycercinae; 2 — Chydorinae; 3 — Aloninae.

Fryer (1963b : 339) stated that the distal of the anal denticles of Eurycercus lamellatus is the largest because the distal part touches the substrate during repulsion. A decrease in the size of the anal denticles proximally is even more marked in some other Chydoridae. If a denticle is situated before the largest denticle (on the distal side of the postabdomen, i.e., the side not facing the substrate), then it is small. The decrease in the size of the anal denticles proximally is not always gradual (Figure 133). Oxyurella tenuicaudis, O. longicaudis, and Rhynchotalona falcata have several large distal denticles followed by small ones. In Oxyurella longicaudis, the large distal denticles are followed by several small ones and then by larger ones which are, however, smaller than the distal ones.

If the anal denticles are well developed, the lateral setae may be small or absent. The suppression of the lateral setae by the anal denticles is more marked in the Chydorinae. The lateral setae sometimes develop at the expense of the anal denticles (Figure 134).

The lateral setae provide contact with the substrate and also clean the legs. The ends of the large lateral setae project beyond the margin of the postabdomen while the anal denticles become reduced or indistinguishable, as in Alona milleri, Acroperus harpae, A. alonoides, Biapertura karua, and especially in most species of Leydigia. The suppression of the anal denticles by the lateral setae is especially marked in the Aloninae.

An effective repulsion from the substrate is sometimes attained not by enlargement of the posterior anal denticles but by a widening of the distal end of the postabdomen (e.g., in Biapertura intermedia). This functional interpretation also explains the changes in the form of the postabdomen with age. In larger females of Pleuroxus truncatus, Pseudochydorus globosus, Tretocephala ambigua, and Kurzia longirostris (i.e., in the Chydorinae and the Aloninae) the distal-dorsal
96 apex becomes longer, so that the dorsal margin becomes concave; in young females, on the other hand, the apex is rounded. The stronger repulsion necessary for larger individuals is attained by lengthening of the apex of the postabdomen and by the development of long distal anal denticles.

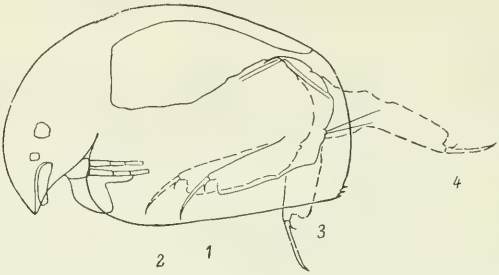

FIGURE 131. Main movements of the postabdomen of Acroperus harpae:

1 — neutral position; 2 — forward movement; 3 — downward movement; 4 — downward-backward movement.

The size of the anal denticles is a specific character which varies little and is largely unaffected by age.

The postabdomen of adult males serves as a penis and is markedly modified in form; the postabdomen of young males resembles that of the females (Smirnov, 1967c).

In contrast to the Daphniidae, the postabdomen of the Chydoridae has a well developed musculature, especially on the dorsal side where the postabdomen comes in contact with the substrate (Green, 1956). Although the postabdomen of the Chydoridae is very long, its muscles are inserted in the proximal part. In the specialized Aloninae, e.g., Acroperus, Camptocercus, and Monospilus, the walls of the abdomen which contain the muscles are strengthened by chitinous elements (apodeme and fulcrum). According to Green (1956), the apodeme and fulcrum stiffen the abdominal part, provide support for the muscles in this area, and prevent bulging out of the abdominal walls during contraction of the muscles. The dorsal parts of the segments are also strongly chitinized, as is the bend between the abdominal part and the postabdomen. This articulation is well developed in the Aloninae; however, it has no chitinous elements in the Eurycercinae, and rotation takes place around the middle, which is supported by internal ligaments.

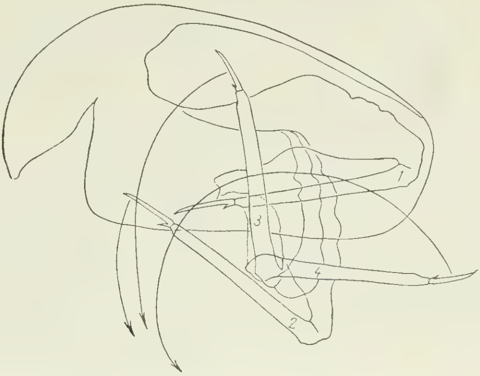

FIGURE 132. Main movements of postabdomen of Camptocercus lilljeborgi (after Green, 1956):

1 — neutral position; 2 — forward movement between the legs and a downward push (for cleaning the limbs); 3, 4 — movements on outer surface of valves (for cleaning the surface).

98 The ventral side of the abdomen has a soft, thin cuticle and forms several folds when the postabdomen bends.

In the specialized species, the postabdomen shows a marked ability to move forward. This movement is usually achieved by lengthening of the abdominal part and of the body (valves), as in Acroperus and Camptocercus. The lengthening is accompanied by a change of the structure of the pump chamber formed by legs III—VI (Smirnov, 1968a). Because of the lengthening of the abdominal part, forms such as Camptocercus lilljeborgi and C. rectirostris can extend the postabdomen outside the valves and make wide brushing movements for cleaning the outer surface of the valves.

The ventral margin of the valves of the Eurycercinae and Aloninae leave a gap in the anterior part for the action of legs I and II. Chydorinae keep their valves open for attachment to the substrate and for scraping food (Figure 135). The integument of Graptoleberis testudinaria has two slightly contrasting functions: it protects the body and legs and at the same time provides contact with the substrate by a wide sole. In Graptoleberis, which shows the extreme degree of adaptation to crawling on the substrate in the Chydoridae, the rostral part of the head shield is curved broadly posteriorly, while the ventral margin of the valves is characteristically straightened in the anterior part.

Graptoleberis moves on the substrate with the help of the antennae, which rest on the surface of surrounding objects and move successively (the antennae of the other Chydoridae remain immobile during movement).

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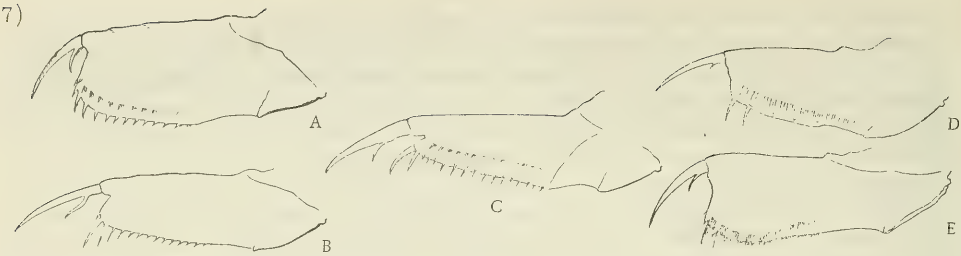

FIGURE 133. Postabdomen and its armature in females (not drawn to scale):

A — the anal denticles decrease proximally and the denticles on the distal margin are small and not in contact with the substrate, Biapertura affinis (Rybinsk Reservoir, 13 June 1961, preparation 40); B — slightly enlarged distal and anal denticles, Oxyurella tenuicaudis (Ivan'kovo Reservoir, 21 July 1962, preparation 636); C — the large distal anal denticles are followed by small denticles and then by larger ones, O. longicaudis (after Birge, 1910); D — the distal anal denticles are large, those proximal to them small and few, Rhynchotalona falcata (Lake Muolan-Yarvi, Karelian Isthmus, 27 July 1956, preparation 715); E — the anal denticles are suppressed by tufts of large lateral setae and the postabdomen widens distally, Biapertura intermedia (Vel'yu River in the Pechora Basin, 2 August 1958, preparation 91).

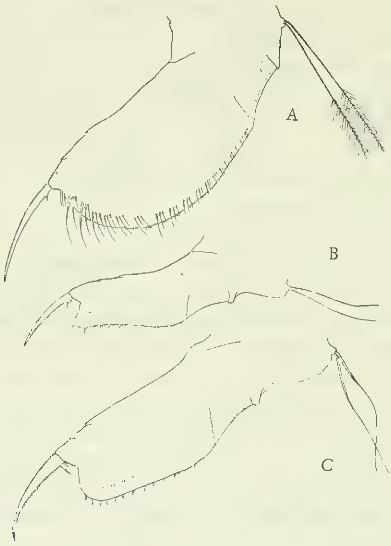

FIGURE 134. Postabdomen and its armature in females:

A — Leydigia leydigi (Ladka River, 14 August 1964), the anal denticles are suppressed by the well developed lateral setae; B — old female Pseudochydorus globosus globosus, length 0.67 mm, postabdomen with produced dorsal distal corner (Sutka River, 11 August 1962); C — young female P. globosus globosus, length 0.49 mm (Cherepovets Reservoir above Goritsy, 10 September 1963).

As in other Chydoridae, movement of Graptoleberis is assisted by repulsion by the postabdomen. Graptoleberis can therefore move in narrow crevices where other Chydoridae cannot move, for example in the thin layer of water under a cover glass. Some Chydoridae overcome obstacles with their antennae (Fryer, 1968). Fryer also found that some species of Chydoridae adhere to the substrate by suction.

The structures of Chydoridae described above permit movement on various substrates, e.g., filiform, spherical, flat, fine-grained, or of irregular form. Acroperus harpae can move along filaments ten to several tens of microns thick and also on small and large pieces of detritus.

(97)

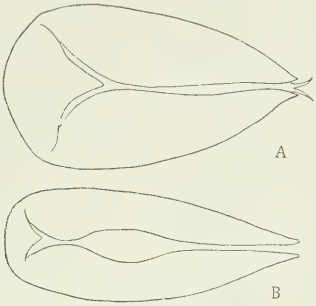

FIGURE 135. Ventral view of carapace:

A — Chydorus sphaericus;
B — Pleuroxus aduncus aduncus.

Eurycercus lamellatus can swim above the silt or crawl on its surface. It sometimes stirs the silt by spiral movements and then continues to feed.

Chydorus sphaericus is the only species found in large numbers in open water. It settles periodically on flakes of algae; the presence of this species in open water apparently depends on such a substrate, since the antennae and legs resemble those of other Chydoridae living on the bottom.

The other species of Chydorus inhabit the littoral. Ch. gibbus and Ch. piger, which occur only in the littoral without vegetation, differ from Ch. sphaericus in their wider postabdomen and an ocellus larger than the eye. Of particular interest is the resemblance in form and armature of the postabdomen of Ch. gibbus and Monospilus dispar, which occur together and in the same environment (on the bottom of littorals without vegetation). On the other hand, the great difference in the mode of life of similar forms such as Chydorus sphaericus and Ch. gibbus is unexplained; nothing is known about the factors which permitted the passage of Ch. sphaericus into the pelagial (although this species has retained its connection with a substrate in the form of lumps suspended in the water).

Another interesting detail is the great resemblance between Leydigia leydigi and Alona quadrangularis in the structure of the setae on the outer ramus of the endite of leg I, the profile of the valve (high posterior margin), and the outline of the postabdomen. These two species have a similar mode of life, viz., they burrow in the silt.

Chydoridae may adhere to the surface film so that part of their integument becomes exposed to air. Most species cannot escape from such a position.

However, Camptocercus rectirostris can break away by strong jerks of the postabdomen and dive again.

As we found in many species and especially in Acroperus harpae, Chydoridae cannot move backward. To move back on a filament, for example, the animal has to turn around, which it does without losing hold of the filament.

A transition to prolonged contact with a substrate is also present in the Macrothricidae, particularly in the group of genera which consists of Acantholeberis, Ophryoxus, Parophryoxus, and in a slightly different form in Ilyocryptus, as noted by Bening (1912). In the Daphniidae and Sididae, a transition to prolonged contact with the substrate is found in some littoral species of Simocephalus and Sida.

The functional complex responsible for the attachment of these species to a surface consists of characteristic formations in the anterior part of the dorsal surface (Claus, 1876). These organs keep the animal from sinking into the silt and prevent clogging of the legs, thus ensuring normal
99 filtration of food and respiration. The legs of these species form a common functional complex which performs the above functions.

In Simocephalus vetulus (O.F. Müller) and S. exspinosus (Koch), the triple head pore is apparently an organ of attachment. The structure of the head pores is similar in these two species and also in S. vetulus vetulus from the Moscow Region and Southern Kirgizia.

Of particular interest is the close resemblance between the pores of Simocephalus and the 3 communicating main head pores of Alona and of Acroperus, Camptocercus, Leydigia, Graptoleberis, and Kurzia. In contrast to the Chydoridae, the head pores of Simocephalus extend transversely. The triple head pore of Simocephalus vetulus (Daphnia sima) was described and drawn by Claus (1876: 385, Plate XXVI, 7d).

We found no head pores in adult Daphnia longispina. The transition of these forms to life in the littoral thus followed a course opposite to that of the Chydoridae and retained the mode of feeding of forms not associated with a substrate. The legs and postabdomen of these species are not modified and resemble those of related pelagic species: the legs are of similar structure, the postabdomen is not lengthened, and the anus is situated at its distal end.

FUNCTIONAL COMPLEX RESPONSIBLE FOR FEEDING AND GAS EXCHANGE WITH THE ENVIRONMENT

These functions are carried out by all appendages except the outer ramus of the endite and the exopodite of leg I.

Feeding

Chydoridae feed on detritus and epiphytic algae. Detritus is their main food.

The intestine of the Chydoridae collected in the Volga basin were filled with detritus particles not larger than 28μ (Table 4).

TABLE 4. Maximum size of particles in the food of Chydoridae

Species	Reservoir	Date of collection	Length, mm	Maximum size of food particle, μ
Eurycercus lamellatus	Rybinsk	23 July 1959	3.2	50
Acroperus elongatus	Rybinsk	20 June 1960	0.63–0.87	8–19
A. harpae	Rybinsk	9 May 1960	0.53–0.71	3–11
Biapertura affinis	Rybinsk	13 June 1961	0.6 –1.0	7–27
Disparalona rostrata	Gorki	12 August 1960	0.44–0.50	5–14
Camptocercus rectirostris	Rybinsk	13 September 1961	0.84–1.19	11–23
Chydorus gibbus	Rybinsk	23 June 1960	0.45–0.56	12–28
Pseudochydorus globosus	Gorki	1 August 1960	0.50–0.68	3–6
Chydorus sphaericus	Rybinsk	9 May 1960	0.34–0.50	8–16
Graptoleberis testudinaria	Rybinsk	24 July 1961	0.48–0.57	5–15
Monospilus dispar	Rybinsk	10 August 1960	0.42–0.47	5–11
Pleuroxus truncatus	Rybinsk	29 August 1961	0.63–0.73	6–11
P. aduncus	Gorki	25 August 1961	0.56–0.67	6–15

Some species of Chydoridae can be cultured on detritus (Smirnov, 1964), where they pass through a complete life cycle. With such feeding, most species produce progeny regularly and repeatedly. *Eurycercus lamellatus*, however, only produced progeny twice (at most), and then it produced ephippial eggs; it probably cannot utilize detritus decomposed to an extent which still sustains the life of the Chydorinae and Aloninae (which are apparently specialized for the utilization of strongly decomposed detritus). If Cladocera which are collected in nature are placed during the fall in a
100 jar with silt for hibernation, *Acroperus harpae*, Daphniidae, and others gradually die, but *Chydorus sphaericus* survives and reproduces until February, feeding on silt thoroughly processed by the other species. Bronshtein (1922) also noted that *Ch. sphaericus* consumes strongly decomposed detritus which is not suitable as food for *Daphnia magna* Straus.

Material collected in rivers (tributaries of the Volga pool of the Rybinsk Reservoir) contained *Pleuroxus striatus* and *Camptocercus lilljeborgi* the intestines of which were filled with epiphytic diatoms, mainly *Cocconeis*. These diatoms adhere firmly to the substrate; the crustaceans had to remove them before feeding. The length of the diatoms was approximately equal to the diameter of the intestine. *Pleuroxus striatus* can be cultured on detritus with only a few diatoms. *Graptoleberis testudinaria* also feeds partly on detritus and partly on diatoms; however, the intestine of some specimens is filled with the large diatom *Epithemia* (Figure 546).

If *Chydorus sphaericus* or *Eurycercus lamellatus* is cultured on green planktonic algae (*Chlorella vulgaris* Beyer, *Ch. pyrenoidosa* Chick., *Ch. terricola* Hollerb., *Scenedesmus* acuminatus (Lagerh.) Chohdat) or blue-green algae (Microcystis aeruginosa Kütz. emend. Elenk., Coelosphaerium dubium Grun., Aphanizomenon flos-aquae (L.) Ralfs., Anabaena scheremetievi Elenk., A. spiroides Kleb.), they always die within a few days without reproducing, and they sometimes die even on the following day. The animals fed on Chlorella in these experiments. The cells of Chlorella passed through the intestine and left via the anus in an unchanged condition.

The crustaceans died more rapidly when fed on live green or blue-green algae than if they were completely starved, apparently because of the secretion of digestive juices for the digestion of unsuitable material. Chydorus sphaericus lives and reproduces for a long time in a recently decayed culture of Coelosphaerium dubium.

The intestine of a specimen of Acroperus harpae contained birch pollen (Rybinsk Reservoir, 12 July 1962, preparation 1489). If there was a choice between filamentous algae, Elodea, or detritus, 90% of A. harpae preferred filamentous algae. The crustaceans feed on epiphytic algae and detritus on the filaments. They gather on lumps of detritus and graze on their surface.

Chydorus sphaericus remains for a long time on the integument of large dead Cladocera overgrown with bacteria. Ch. sphaericus and Eurycercus lamellatus live and reproduce for a long time on bacteria (Rodina, 1949, 1950, 1958). Chydorus sphaericus digests bacteria which oxidize methane and hydrogen (Sorokin, 1959).

The composition of the diet varies greatly according to the food available in the environment of each individual. The diet also depends on seasonal changes in the algae and the quality of detritus.

Anchistropus emarginatus lives and feeds on hydrae. When it finds a hydra, this animal grasps it with the valves and the first pair of legs. It scrapes the tissues of the hydra with the setae of the endites of the second pair of legs, and apparently also with the setae of the endites of the third pair of legs and the hooks of the first pair of legs (Borg, 1935a, 1935b, 1936). A. minor also lives on hydrae. A specimen of Hydra oligactis Pallas was covered with 50 crustaceans (Hyman, 1926), which killed the hydra. Many Chydoridae (Pleuroxus trigonellus, P. striatus, P. aduncus, P. truncatus, Chydorus sphaericus, Acroperus harpae, and Eurycercus lamellatus) can be cultured for long periods on decaying plants.

If the food is suitable, the crustaceans remain on it for a long time and move across it before beginning to feed. Swimming is an auxiliary activity aimed at finding suitable food. One female Acroperus harpae with a deformed left antenna which consisted only of an underdeveloped first segment contained developed embryos and fed normally (Rybinsk Reservoir, Borok, 19 July 1965, preparation 437). The selective approach to food observed in the Daphniidae with their much less differentiated appendages (Gaevskaya, 1949), is quite evident in the specialized Chydoridae. Chydoridae have unlimited food resources during the whole period of active feeding (April-May in the temperate latitudes of the Northern Hemisphere).

The Chydoridae may be considered as a group which introduces dead organic material at different stages of decay into the trophic cycles.

The Chydoridae first scrape the food, then pass it to the filtration chamber, and finally filter it. The act of filtration itself provides food in the Sididae and Daphniidae.

101 Morphology and operation of the structures which take part in feeding

Observations of the action and position of the legs of Chydoridae were made on material collected mainly in the littoral of the Rybinsk Reservoir. The figures are drawn from live material.

According to the data of Fryer (1963b) for Eurycercus lamellatus and our own observations, most species of Chydorinae and Aloninae scrape food from the surface of the substrate with the second pair of legs, i.e., with the hard setae of the endites. The food is passed to the filtration chamber, which consists of the filtering fans of the setae of the gnathobase and of the endites of legs II–V. In many Chydoridae, the movements of the exopodites of legs IV and V create a current of water flowing from the posterior margin of the valves (which is more or less truncate in the Chydoridae). The food particles reach the end of the feathered setae which form the filtration chamber (moving in the direction of the feathering); they are then passed anteriorly along the food groove. There are no currents directed anteriorly. Near the first pair of legs, the food particles are cemented together with the secretion of the glands of the labrum. The maxillules and mandibles then pass the food to the mouth. If an excessively large mass of food is formed before the mouth it is discarded, since it cannot be swallowed (Fryer, 1963b: 375).

The scraping of food from the substrate is done mainly by the endite of leg II together with the endite of leg III and the inner ramus of the endite of leg I. The crustacean moves either straight forward or in a spiral along the filament or detritus particle, thus cleaning it thoroughly. The inner ramus of the endite of leg I prevents the food falling down. The perceiving part of the third functional complex is the inner seta of the inner ramus of the endite of leg I, possibly together with some setae of the endites of legs III–V. In primitive forms such as Eurycercus glacialis and E. lamellatus, the row of hard setae on the endite of leg II is accompanied by a parallel row of soft setae which are apparently tactile. In the even more primitive Macrothrix, the row of hard setae on the endite ends on the gnathobase in a sensilla (chemoreceptor); the absence of this sensilla in the Chydoridae may be due to the fact that the sensilla on the endite of leg III has a similar function.

The functional complex discussed here also includes the filtration chamber and the pump chamber (the latter is not functional in all Chydoridae). The filtration chamber concentrates the food and passes it to the mouth. The performing part of the filtration chamber is a tubular cavity the reticulate walls of which are formed by the feathered setae of the gnathobase and endites; the cavity is closed above by the lower side of the body and below by the closed endites of legs III–V.

The filtering fans of leg V of the Chydorinae and Aloninae are markedly reduced and the filtration chamber consists mainly of the fans of legs II–IV.

The perceiving part of the filtration chamber consists of sensillae (chemoreceptors) situated on the endites along the food current; such sensillae were found on legs III, IV, and V of Eurycercus lamellatus (Fryer, 1963b) and on legs III and IV of other genera of Chydoridae (Smirnov, 1967a). Tactile setae may also be present on the gnathobase forming the filtration chamber.

The pump chamber (Figures 136—143) creates the water current which drains excess water from the filtration chamber, washes the epipodites, and is used for perception by the chemoreceptors on the antennae. The performing part of the pump chamber consists of the exopodites of legs III—V (and leg VI, if present). It is covered above by the closed endites of legs III—V; the postabdomen is situated between the exopodites. The anterior tactile setae of the exopodites are the perceiving part of the pump chamber.

The pump chamber is situated lateral to and behind the filtration chamber. In the very elongate Camptocercus, only the exopodite of leg V takes part in the rhythmic movement, while the exopodites of legs III and IV cover the pump chamber laterally and below.

Observations of live crustaceans show that continuous rhythmic vibrations of legs IV and V take place in Eurycercus lamellatus, Pleuroxus striatus, P. aduncus, P. trigonellus, P. uncinatus, Alonella excisa, Chydorus gibbus, Acroperus harpae, and Biapertura affinis (Table 5). Legs IV and V of Leydigia leydigi do not vibrate continuously but may rest periodically, especially during swimming.

Leg VI moves only rarely in Eurycercus lamellatus and is immobile in Pleuroxus striatus.

The frequency of strokes is lowest in Chydorus sphaericus. In Rhynchotalona falcata, Monospilus dispar, and Graptoleberis 104 testudinaria, the exopodites of the legs do not make rhythmic vibrations (Figure 144). The direction of the water current created by the pump chamber is shown in Figure 145.

TABLE 5. Frequency of strokes of exopodites of legs IV and V per minute

Species	Frequency of strokes	t, °C
Pleuroxus aduncus	300	23
P. uncinatus	300	23
Chydorus sphaericus	170	23
Alona quadrangularis	290	23
Acroperus harpae	270	18
Daphnia magna (McMahon and Rigler, 1963)	231	20

An individual of Eurycercus lamellatus can filter up to 20.5 ml water daily (Marcolini, 1953) or up to 30.6 ml (according to Kryuchkova).

The water current created by the pump chamber can be made visible by the addition of india ink. A cone of water ejected posteriorly can be seen by observation from above.

Analysis of the performance of such different functions as feeding and gas exchange shows that the pump chamber, which consists of legs III—VI, takes part in both activities. This is a combination of functions.

The food moves toward the mouth because the feathering of the rows of setae which form the filtration chamber is directed anteriorly and dorsally; each movement of the legs therefore moves the food in the proper direction. Near the mouth, the food is moved by the maxillules, assisted by suction

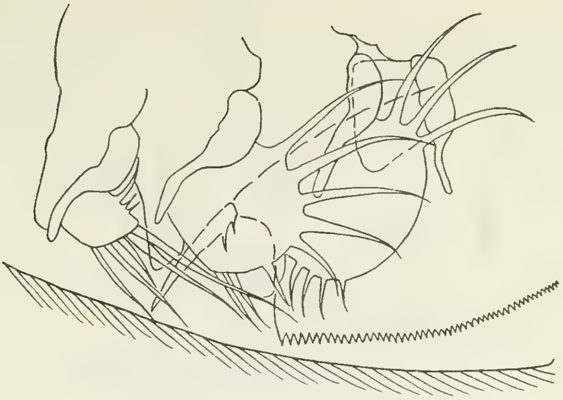

FIGURE 136. Position of legs III–VI of Eurycercus lamellatus (female, live material, Rybinsk Reservoir, Borok)

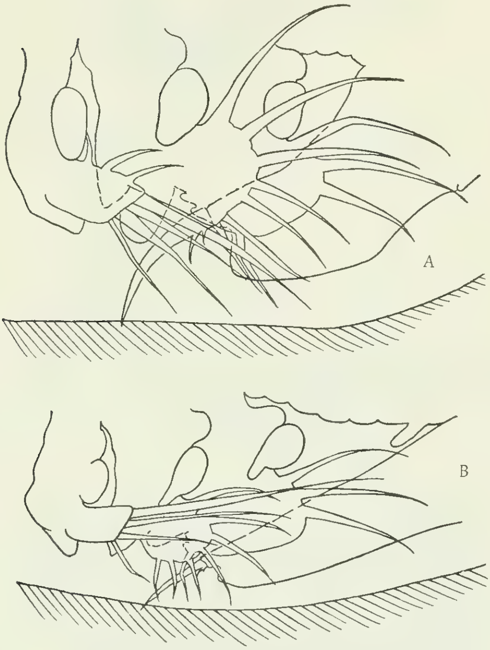

FIGURE 137. Position of legs III–VI of Pleuroxus (female, live material, Rybinsk Reservoir, Borok):

A – P. uncinatus; B – P. striatus.

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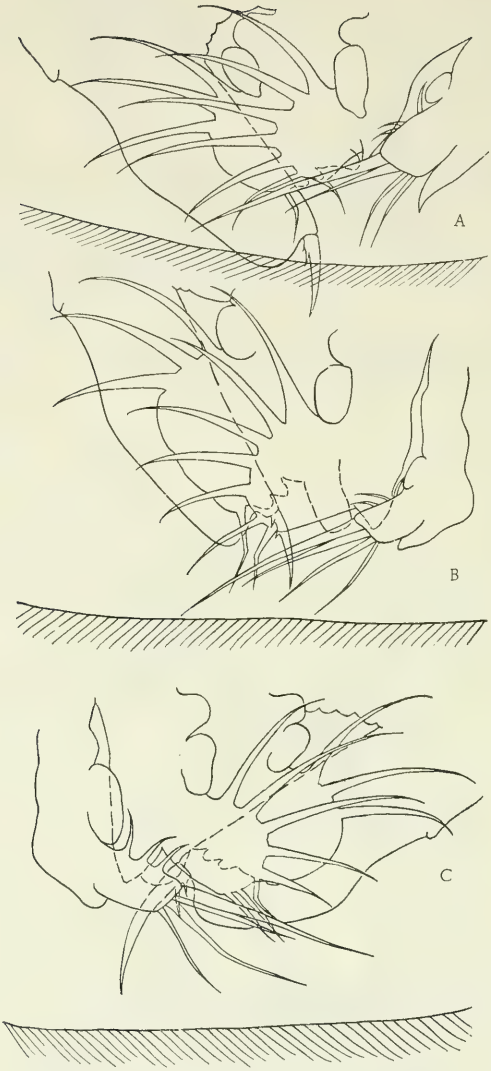


FIGURE 138. Position of legs III–V of Pleuroxus (female, live material, Rybinsk Reservoir, Borok):

A – P. truncatus truncatus; B – P. trigonellus trigonellus; C – P. aduncus. (Not drawn to scale.)

during swallowing. The endopodite of leg I has a special musculature and also moves the food toward the mouth (if this endopodite is present). In Eurycercus glacialis we found two muscles which extend in slightly different directions. The gnathobase of the mandibles does not grind food; its function is to form a food current directed toward the mouth, as shown by Fryer (1963b) for E. lamellatus.

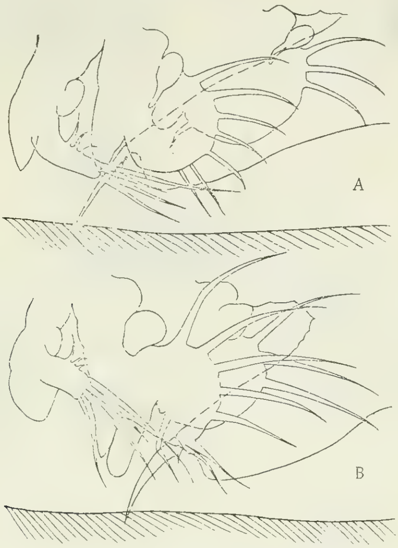


FIGURE 139. Position of legs III—V (female, live material, Rybinsk Reservoir, Borok):

A — Alonella excisa excisa;
B — Disparalona rostrata rostrata.

Filtration takes place with the fringe of setae on the ventral edge of the valves. The feathering of these setae is directed posteriorly, as in the setae of the leg exopodites which pump the water. The valves of some Chydoridae have a strongly convex ventral margin the setae of which are distant from the limbs; such forms show a transition of the setae to the inner surface of the valve closer to the legs. Such a displacement toward the legs takes place in the posterior half of the ventral margin of the valve in the area of the pump chamber (Figure 146). This takes place independently in the subfamilies Chydorinae and Aloninae. The fringe of setae on
107 the ventral margin of the valves protects the legs from becoming clogged. The posterior margin of the valve has no setae or only small ones, since the water current leaves the carapace at this point and there is little risk of clogging. The setae on the ventral margin of the valve are little developed in pelagic Daphniidae.

The normal position of the postabdomen is between legs V; the brush of lateral setae on the postabdomen cleans legs V and the long setae on the exopodite of legs IV. The claw of the postabdomen cleans the legs and

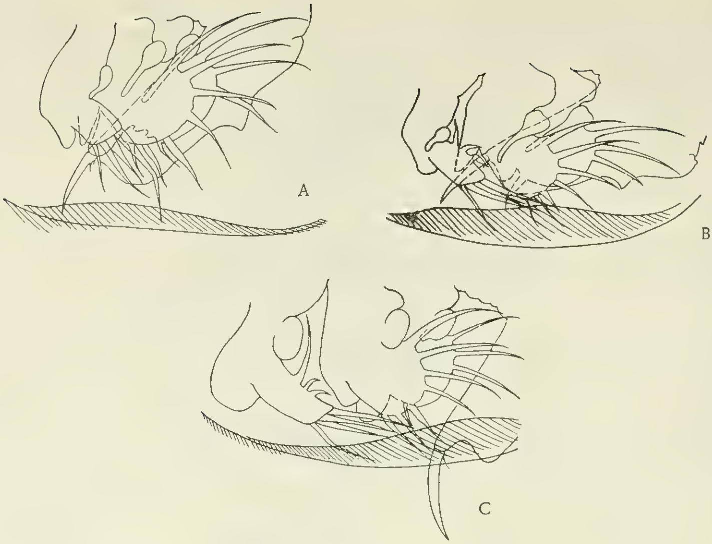


FIGURE 140. Position of legs III — V (female, live material, Rybinsk Reservoir, Borok):

A — Chydorus gibbus; B — Ch. sphaericus; C — Pseudochydorus globosus globosus.

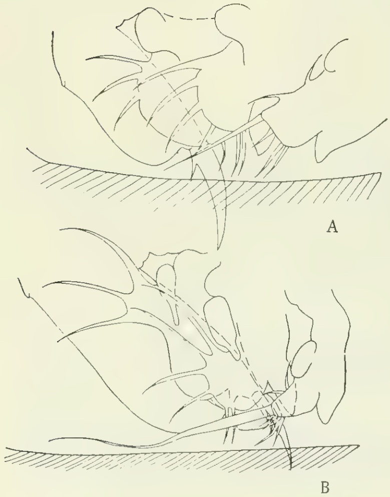


FIGURE 141. Position of legs III — V (female, live material, Rybinsk Reservoir, Borok):

A — Alona rectangula; B — Biapertura affinis.

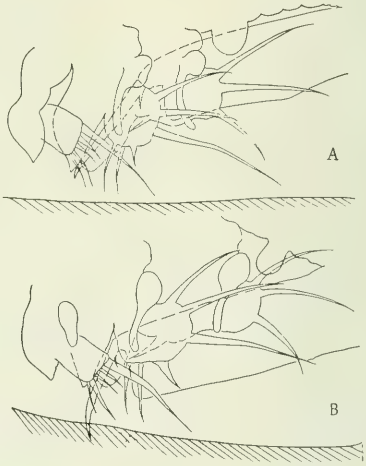


FIGURE 142. Position of legs III—VI (female, live material, Rybinsk Reservoir, Borok):

A — Acroperus harpae; B — A. elongatus elongatus.

(106)

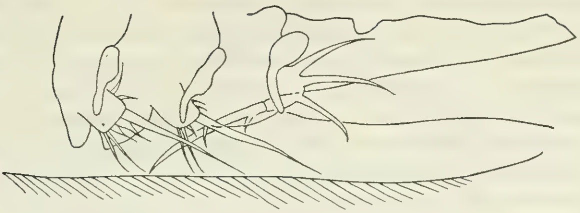


FIGURE 143. Position of legs III—VI of Camptocercus rectirostris (female, live material, Rybinsk Reservoir, Borok)

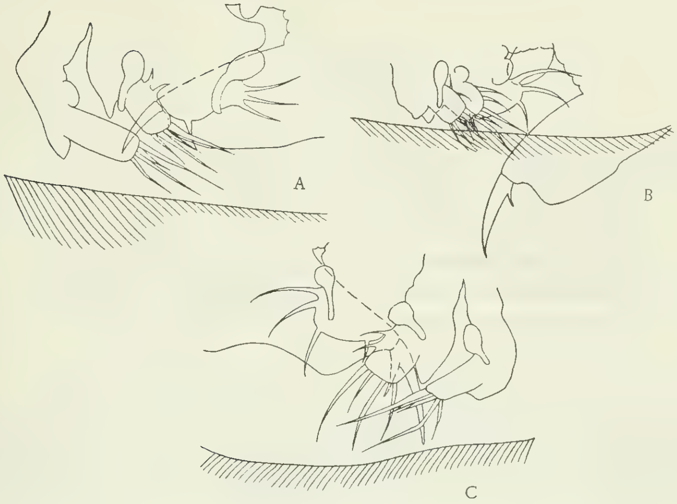


FIGURE 144. Position of legs III—V (female, live material, Rybinsk Reservoir, Borok):

A — Graptoleberis testudinaria; B — Rhynchotalona falcata; C — Monospilus dispar.

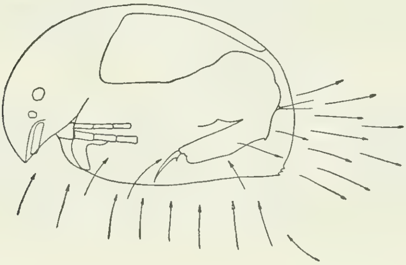


FIGURE 145. Water currents created by Acroperus harpae

pushes unsuitable lumps of food away from the mouth. We found a female of Eurycercus lamellatus which had neither claws nor some of the denticles of the postabdomen (preparation 62, Figure 98). To judge from the blood coagulated at the injury, no molt took place after the loss of the claws. Despite the absence of claws, the crustacean was able to move normally on the substrate and to swim normally; it could also feed (the intestine was filled). A specimen of Pleuroxus uncinatus without a claw had two embryos in the brood pouch and a filled intestine (preparation 2216).

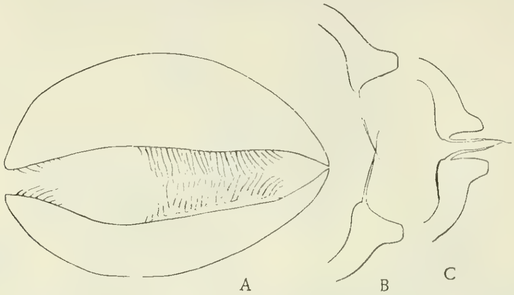


FIGURE 146. Valves of Chydorus sphaericus (after Franke, 1925); setules not shown:

A — ventral view; B — cross section with open valves; C — cross section with closed valves.

If the postabdomen is in the normal position, the apex of the claw is situated below the apex of the gnathobase of leg VI. If the postabdomen moves posteriorly to propel the body from the substrate, the claw cleans the setae of legs III and IV. The basal spine of the claw also takes part in the cleaning of the legs. This is the reason for the presence of setae on the concave margin of the claw as well as on the basal spine. The tufts of lateral setae are more developed in the distal part of the postabdomen, where they take a greater part in cleaning the legs and the setae on the ventral margin of the valves.

If the postabdomen is in the neutral position, the convex side of the claw forms a continuation of the ventral margin of the postabdomen. When the postabdomen returns to this position after being turned back, the claw may be slightly bent close to the leg setae, which facilitates its movement between the setae.

In the primitive species of the genus Eurycercus, the anus is situated in the distal part of the postabdomen. In other Chydoridae, the anus is displaced to the functionally lower side of the postabdomen, while in the specialized Dunhevedia it is situated on the posterior side of the postabdomen (Figure 25). This displacement of the anus prevents clogging of the complex apparatus with feces.

The anal denticles of the postabdomen serve mainly for better adhesion to the substrate. The marginal setae of the anus prevent the entry of particles. One of the factors which determine the structure of the postabdomen is the need for cleaning the highly specialized leg apparatus from fecal material, which is abundant in the littoral, especially because of the mode of feeding of the Chydoridae. Another factor is establishment of contact with the substrate. The abundant development of Chydoridae in the littoral is mainly due to the specialized postabdomen. The abundant impurities in the littoral preclude the life of species which have no cleaning apparatus.

Illumination of the substrate is not necessary for collection of food with the legs. Chydorus sphaericus can feed, grow, and reproduce well and for a long time in total darkness and shows little difference from controls kept in the light (Smirnov, 1965c). This result is not surprising, in view of the twilight in the turbid waters of the littoral.

108 GAS EXCHANGE

Gas exchange in the Chydoridae takes place under difficult conditions, among decaying detritus; this is especially abundant in vegetation so that the mixing of water (with the surface layers and with the pelagial water) is much reduced.

Gas exchange with the environment is carried out by the epipodites of legs I—VI and by the pump chamber. The processes of the epipodites increase their surface. Small Chydoridae have a greater surface than large ones.

In the subfamily Eurycercinae, all six pairs of legs bear epipodites; the epipodites of Eurycercus glacialis have no processes but those of E. lamellatus do have them. In the subfamily Sayciinae, Saycia cooki bears five pairs of epipodites in accordance with the number of legs; the epipodites are ellipsoidal and without processes. Some species of the subfamilies Chydorinae and Aloninae have processes on the epipodites and some do not.

TABLE 6. Oxygen uptake and food requirements of Chydoridae (at 20° C)

Species	Oxygen uptake ml O_2 per 24 hours per g live weight	Energy expenditure for respiration, calories per 24 hours per g live weight	24-hour ration	
			% of body weight	calories per g live weight
Chydorus sphaericus	16.8 (after Belyatskaya, 1959a)	84	37 (Sushchenya, 1959)	503
Ch. ovalis	5.9 (after Yatsenko, 1928a, 1928b)	29.5	—	—
Eurycercus lamellatus, length 1.6 mm	17.5	67 67	6,000	1,510
E. lamellatus, length 1.9 mm	14.4	65	2,500	630

Leg II is less mobile than the other legs; its epipodite usually has no processes. The epipodites of the pelagic Daphniidae are without processes.

Vital staining of Eurycercus lamellatus and Aloninae showed cavities at the main head pores and also canals from the small pores into the tissue. The stain is taken up in a small area around each head pore; the small pores do not stain. These areas have a small surface, and their respiratory function mentioned by Franke (1934) is apparently of little importance.

There are some data available on the oxygen uptake of Chydoridae (Table 6). The table also gives data on the energy metabolism.

FUNCTIONAL COMPLEX RESPONSIBLE FOR THE DIGESTION OF FOOD

The intestine of the Chydoridae is divided into fore intestine or esophagus, mid-intestine, and hind intestine (behind the caecum). In Eurycercus, the anterior part of the mid-intestine bears two dorsal caeca (hepatic processes); the caecum in the posterior part of the mid-intestine is short.

The esophagus begins with the mouth, bordered by the well developed labrum which bears a plate-shaped process in the Chydoridae (except Pseudochydorus globosus). In the labrum are situated the labral glands (salivary glands). The labium has no appendages and cannot move independently. The mid-intestine is long and forms 1–2 loops. On the ventral side of the posterior end is a caecum directed anteriorly (Figure 57). The hind intestine is short. The anus is situated as follows: at the end of the postabdomen in Eurycercus; in the proximal part of the postabdomen in most Chydoridae; on the posterior side of the postabdomen in Dunhevedia.

The hind intestine forms a widening near the anus. This widening is situated mainly in the postabdomen and is protected dorsally and laterally by articulated elements of the postabdomen (situated at the border with the abdomen).

Observations of the function of the intestine were made on live specimens from the littoral of the Rybinsk Reservoir and from ponds of the Yakot' fish farm. Chydoridae feed intensively, often swallowing whole lumps of food.

The esophagus makes swallowing movements which suck in the food. The food is held before the mouth by the mandibles together with the setae of the maxillules, filtration chamber, and ventral side of the abdomen; all these setae are directed anteriorly.

109 The food is moved along the intestine by peristaltic contractions of the mid-intestine. With each contraction, the food in the anterior part of the mid-intestine returns some distance back, and the next contraction then begins. The food thus moves back and forth, but the resulting movement is posteriorly. Such movements of the food take place throughout the mid-intestine. The hepatic processes also contract periodically from their apex to the base. Antiperistaltic contractions take place from time to time in the posterior part of the mid-intestine, decreasing gradually anteriorly; they displace the posterior end of the food column anteriorly from the

caecum. Such movements take place repeatedly before the food mass passes this area. The Chydoridae feed mainly on detritus, which is of low nutritive value; their mid-intestine is therefore long and usually looped. An Acroperus harpae of length 0.72 mm (from the rostrum to the posterior margin of the valve) had an intestine of length about 730μ. An abnormal lengthening of the intestine may occur, as Lilljeborg (1900) found in Chydorus sphaericus latus.

The antiperistaltic contractions begin in the hind intestine and spread to the caecum and posterior part of the mid-intestine (according to observations on live Pleuroxus striatus, P. aduncus, P. trigonellus, P. uncinatus, P. truncatus, Disparalona rostrata (males and females), Alonella excisa, Chydorus sphaericus, Ch. gibbus, Alona quadrangularis, Camptocercus rectirostris, Graptoleberis testudinaria, Acroperus elongatus, Biapertura affinis, Rhynchotalona falcata, and Monospilus dispar). These contractions take place a few at a time, at intervals.

Water enters through the anus as a result of the antiperistaltic movements of the hind intestine. Fox (1952) observed anal intake of water in Sididae, Daphniidae, Leptodora, and Bythotrephes, but not in Evadne or Podon.

Defecation is followed by antiperistaltic contractions of the hind intestine in rapid succession (according to observations on live Pleuroxus and Acroperus); there are about ten such contractions in Acroperus harpae at a gradually decreasing frequency after defecation. The Chydoridae ingest particles of food or water without food, according to observations on live Chydorus gibbus and Acroperus harpae. After a three-minute exposure to a 5% solution of Congo red, the anterior and posterior end of the food column become orange (the middle remains brown), and a pale orange liquid fills the anterior part of the mid-intestine (this indicates that these areas have a pH higher than 5.2). Animals placed for three minutes in a methylene blue solution also show blue staining of the contents of the posterior part of the mid-intestine and of the caecum in the anterior part of the mid-intestine.

The water entering through the anus compensates for the volume of the feces and prevents the food from moving too rapidly. Since the intestine of the Chydoridae has no sphincter, the antiperistalsis acts as a physiological sphincter.

The caecum shows a marked capacity for distension. Its length in adult Acroperus harpae (length 0.72 mm) is 130μ. As the food moves toward the posterior end of the mid-intestine, part of it enters the caecum; this involves a displacement in the direction of movement of the food. Food never passes directly from the mid-intestine into the rectum. The accumulation of feces in the caecum makes long intervals between defecations necessary, and the feeding periods are accordingly long (the animals do not feed during defecation).

Green (1956) assumes that the accumulation of feces in the hind intestine may interfere with the action of the muscles which move the postabdomen.

Periodic antiperistaltic contractions take place from the base to the apex of the caecum. The entering of each food particle is followed by a number of such contractions, so that each particle is pressed to the apex of the caecum before entry of the next particle.

The empty caecum has a small lumen; however, it widens considerably with the arrival of digested food. When filled with feces, the caecum of Acroperus harpae has an inner width of 60μ and a length of 140μ. Food particles enter the caecum until they can no longer be compressed by antiperistaltic movements and they may even protrude partly from the caecum into the intestine during the contractions. Defecation then begins, and only the contents of the caecum are evacuated. We observed this in live Pleuroxus striatus, P. aduncus, P. truncatus, Alonella excisa, Chydorus sphaericus, Ch. gibbus, Graptoleberis testudinaria, and Acroperus harpae.

The feces pass from the mid-intestine into the small caecum in Eurycercus lamellatus. Defecation evacuates the caecum together with a large part of the mid-intestine. The caecum of Eurycercus, has not yet assumed the role of a fecal vesicle. Its main purpose here is apparently to
110 trigger defecation rather than to contain the feces. Solid particles may also be drawn in during the antiperistaltic ingestion of water. In E. lamellatus, the antiperistaltic contractions of the hind intestine which follow defecation cause the ingestion of water together with particles including feces if these are still in the vicinity. The marginal setae of the anus have their ends directed outward and tend to prevent such penetration. These observations explain the existence and function of these setae. Another protection against the entering of particles into the anus during antiperistaltic ingestion of water is the presence of large proximal anal denticles in Chydorus barroisi, Ch. poppei, and Ch. hybridus. In Daphnia carinata turcomanica Manuilova, the margin of the anus bears spines and long hairs (Manuilova, 1964, Figure 46, *14, 16*).

There is no caecum at the posterior end of the mid-intestine of the Sididae and Daphniidae. These families make strong antiperistaltic movements with the intake of water and partial return of previously deposited feces (we observed this in Sida crystallina (O. F. Müller) and Daphnia pulex De Geer). We found antiperistaltic contractions of the hind intestine and the posterior part of the mid-intestine in D. pulex, D. longispina (O. F. Müller), Ceriodaphnia affinis Lilljeborg, C. reticulata (Jurine), Moina macrocopa Straus, and Bosmina longirostris (O. F. Müller). When Simocephalus vetulus vetulus (O. F. Müller) is placed in a solution of neutral red, the solution fills the hind intestine by anal intake of water.

Quantitative data on the function of the intestine of Acroperus harpae per minute at 17.5° C in feeding specimens

Peristaltic contractions in anterior part of mid-intestine	8—9
Antiperistaltic contractions of posterior part of mid-intestine	2—5
Antiperistaltic contractions of caecum	2—3
Antiperistaltic contractions of hind intestine immediately after defecation (three in succession)	6
Food particles entering the caecum	2
Movements of mandibles	up to 160
Swallowing movements	23
Food particles swallowed (food is not taken in with every swallowing movement)	20

We calculated the 24-hour ration of Acroperus harpae from the size of the intestine, the size of the food particles, and the frequency of ingestion and defecation according to observations of live specimens.

The food forms a continuous column in the mid-intestine from the beginning almost to its end. The mid-intestine is 24μ wide over most of its length, so that the volume of the food column is $700\times 24^2:2^2\times 3.14=317{,}000\mu^3$: The ration can be calculated, since it is known that an adult A. harpae of the above length weighs 0.02 mg. The caecum contains food particles about $50\times 24\mu$ large, which corresponds to a volume of $22{,}600\mu^3$. The ingested particles measure $30\times 20\mu$ and have a volume of $9{,}420\mu^3$. From 14 to 19 food particles enter the caecum between defecations, and the interval between defecations is 4.5–5 min.

When determining the 24-hour ration, one must take into account that feeding is not continuous; there are intervals in feeding, and time is also spent swimming and in search of food. The crustacean rests on the substrate most of the time, but even then it does not feed continuously, and it may be assumed that the feeding time is 12 hours daily. The calculation can be made in three ways: from the quantity of material entering the caecum; from the quantity of feces; from the quantity of ingested food. The caecum receives 3 food particles of volume $22{,}600\mu^3$ per minute. The corresponding quantity per 24 hours is $22{,}600\times 3\times 720=48{,}800{,}000\mu^3$ (0.0488 mg), which is a 24-hour ration of 250% of the live weight.

If one defecation evacuates $396{,}000\mu^3$ of food from the caecum and the interval between defecations is 5 min, then there are 144 defecations per 24 hours (this is obviously an overestimate, since the animal feeds only half the time). The quantity of discarded food per 24 hours is $57{,}000{,}000\mu^3$ or 0.057 mg, which corresponds to a ration of 253%. Since the food column is 700μ long and the caecum is filled by 14 particles each about 50μ long, the contents of the intestine can fill the caecum at once.

If 20 particles of size about $30\times 14\mu$ are ingested per minute, i. e., $30\times 20\times 49\times 3.14\times 720=56{,}400{,}000\mu^3$, the 24-hour ration is 253% (or more if the crustacean feeds a longer time each day).

The 24-hour ration of Chydoridae which feed mainly on detritus may be much greater than stated above (Smirnov, 1962b). Eurycercus lamellatus defecates up to 217 times daily, i. e., every 7 minutes.

111 TABLE 7. Time of death after starvation

Species	Time of death of 50% of specimens, days	Time of death of 100% of specimens, days	t, °C
Acroperus harpae	1	17	17–19
Camptocercus rectirostris	3	8	17–19
Chydorus sphaericus	10	—	15–18

The prolonged period of death (Table 7) is probably due to the penetration of dust into the containers. In one vessel in which Camptocercus rectirostris was cultured on detritus, the supply of detritus was restricted after one of the specimens produced parthenogenetic progeny 6 times. As a result, the animal formed an ephippium and died on the 20th day. If Chydorus sphaericus is given food until the eggs are developed and feeding is then stopped, the progeny obtained contains 7% males (Mortimer, 1936).

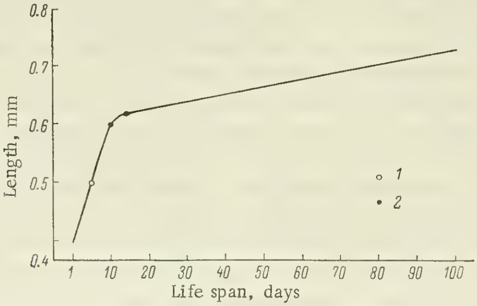


FIGURE 147. Generalized growth curve of Chydoridae after experimental data on Pleuroxus truncatus truncatus:

1 — first appearance of eggs in the brood pouch; 2 — first and second batch of progeny.

In conclusion, we give data on the growth of Chydoridae. Some data on the growth may be obtained from material collected in nature (Table 8). Werner (1924) studied the growth of Chydoridae by statistical analysis of 113 size groups. Although growth ceases soon after maturity, numerous molts take place. In our experiments, which continued throughout the life of the specimens, we observed tens of stages in each species (Table 11). Since growth takes place only at the beginning of life, Werner only observed the following number of stages: 8 for Acroperus harpae, 7 for Camptocercus lilljeborgi, 5 for Pleuroxus aduncus, 7 for Chydorus sphaericus, and 6 for Pleuroxus truncatus; these figures are much lower than the actual number of molts in the above species. Cheremisova (1958) found more than 30 stages in Chydorus sphaericus under experimental conditions. Rammner (1928) and Cheremisova (1958) cultivated isolated individuals of Chydoridae without waiting for the death of the animals; they thus determined the number of molts and batches of progeny during an indefinite part of their life. The growth of all the Chydoridae examined slows down with the appearance of eggs in the brood pouch and practically ceases after the deposition of the first batch of progeny (Figure 147). The growth curves of the crustaceans examined have a uniform course (Zaffagnini, 1964; Smirnov, 1964). Eurycercus lamellatus grew slowly in an experiment in which 10 isolated specimens were fed entirely with bacteria grown in filtered natural water. They attained a maximum length of 1.7 mm. Fifty percent of the specimens died in 18 days, and none lived for more than 24 days. Most of the specimens (7) molted

(112)

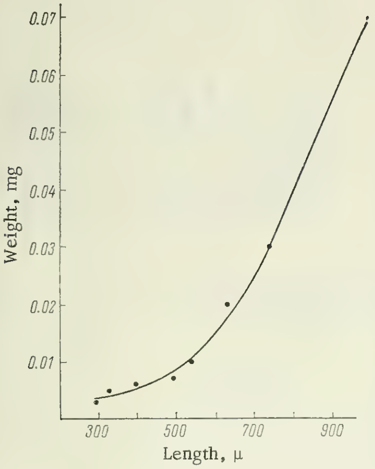


FIGURE 148. Relationship between length and weight of Acroperus harpae (after Kosova, 1961)

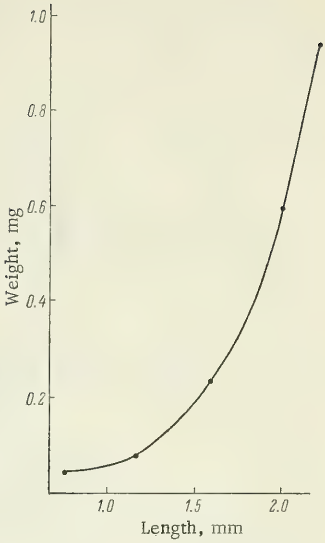


FIGURE 149. Relationship between length and weight of Eurycercus lamellatus

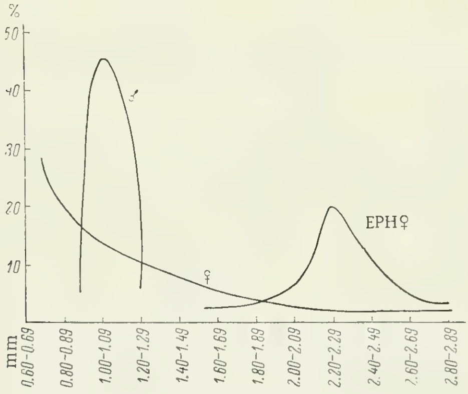


FIGURE 150. Distribution of length of Eurycercus lamellatus:

♀—females which reproduce parthenogenetically (9 August 1962, Sunozhka River); EPH♀—ephippial females and ♂—males (20 October 1963, Cherepovets Reservoir).

(111) TABLE 8. Size of Chydoridae after field material

Species	Date of collection	Reservoir	Minimum length, mm	Minimum length of gravid individuals, mm	Maximum length, mm	Maximum number of eggs
Acroperus harpae...	9, 19 May 1960	Rybinsk	0.40	0.61	0.81	2
Biapertura affinis ..	13 June 1961	Rybinsk	0.46	0.71	1.05	2
Acroperus elongatus	20, 23 June 1960	Rybinsk	0.51	0.69	0.85	2
Camptocercus rectirostris	13 September 1961	Rybinsk	0.72	0.90	1.26	2
Chydorus gibbus ...	23 June 1960	Rybinsk	0.84	—	0.56	—
Pseudochydorus globosus	1 August 1960	Gorki	0.37	0.42	0.65	2
Chydorus sphaericus	9 May 1960	Rybinsk	0.27	0.30	0.52	2
Eurycercus lamellatus	13 September 1961	Rybinsk	0.8	1.6	3.1	24
Monospilus dispar	10 August 1960	Rybinsk	0.28	0.35	0.47	2
Graptoleberis testudinaria	29 July 1961	Rybinsk	0.31	0.42	0.62	2
Pleuroxus truncatus	1 August 1960	Gorki	0.48	0.49	0.65	2
P. aduncus	12 August 1961	Gorki	0.36	0.50	0.66	2
Disparalona rostrara	12 August 1960	Gorki	0.35	0.39	0.50	2

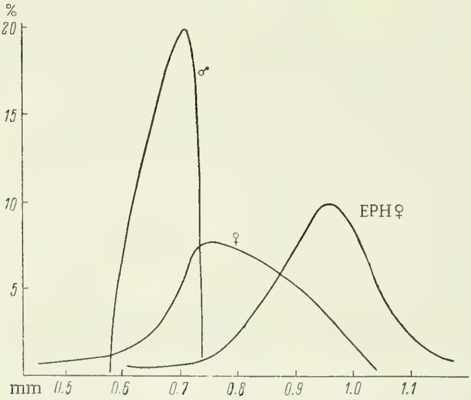


FIGURE 151. Distribution of length of Biapertura affinis (Rybinsk Reservoir):

♀ — females which reproduce parthenogenetically (13 June 1961); EPH ♀ — ephippial females and ♂— males (2 October 1962).

5 times; the others molted at least 3 times. The animals did not attain maturity and did not produce ephippia. This indicates that feeding and other environmental factors have a major influence on the growth rate, definitive length, and age of maturation. Konstantinova (1957) found that the growth of Chydorus sphaericus slows down on the 4th day of life and ceases on the 12th day. Growth is accompanied by changes in the form of the body and its different parts. The relationship between length and weight is shown in Figures 148 and 149. The relationship is parabolic. Figures 150 and 151 show the distribution of the length of parthenogenetic and ephippial females and males. The biomass is calculated according to the weights given in Table 9.

TABLE 9. Length and weight of Chydoridae (after Mordukhai-Boltovskoi, 1954)

Length, mm	Weight, mg	
	Chydorus, Monospilus	other Chydoridae
0.3	0.002	—
0.4—0.5	0.009	0.005
0.5—0.7	0.018	0.02
0.7—0.9	—	0.05
0.9—1.1	—	0.1

FUNCTIONAL COMPLEX RESPONSIBLE FOR DISTRIBUTION OF ASSIMILATED FOOD AND FOR GAS EXCHANGE IN THE INTERNAL ORGANS

The assimilated material enters into the blood, which is circulated by the contractions of the heart and washes all internal organs. The blood flow is directed mainly from the heart anteriorly on the dorsal side; in the head region it becomes directed toward the legs and then proceeds to the posterior end of the body and reaches the heart from behind on the dorsal side (Figure
114 152). In Eurycercus lamellatus, the blood flow enters the postabdomen (it washes the hind intestine, which opens at the distal end of the postabdomen); the blood does not circulate in the postabdomen of other Chydoridae, as we observed in Acroperus harpae. The intestinal peristalsis can stop the blood flow and even reverse it for short periods. The direction of the blood flow in Eurycercus lamellatus is shown in Figure 152. There is a whirl in the blood flow near the head pore, so that most hemocytes remain for some time near the head pore before moving further. The blood flow changes direction near the eye and passes posteriorly, partly below the valves and partly below the intestine, and then enters the legs. At the posterior end of the body the blood turns around and flows partly above the intestine and partly along the valves. Acroperus harpae has a similar circulation, although in this species blood with hemocytes does not enter the postabdomen (Figure 153).

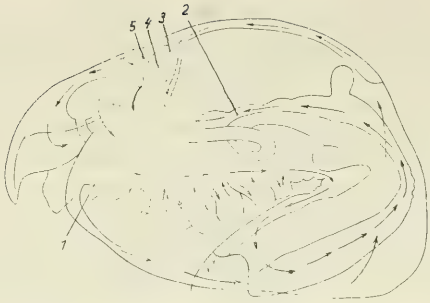


FIGURE 152. Direction of the flow of hemolymph in Eurycercus lamellatus:

1 — arterial stream; 2—venous stream; 3—heart; 4 —ostium laterale; 5 — whirl.

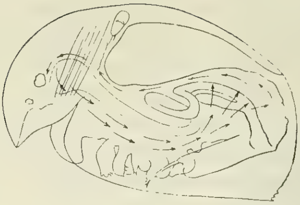


FIGURE 153. Direction of the flow of hemolymph in Acroperus harpae (Rybinsk Reservoir, Borok)

We determined the rate of heartbeats in some species (Table 10; Smirnov, 1965d) because of its metabolic importance. As shown in the table, the two sexes have heartbeat rates of the same order of magnitude. The rate rises for a short period as a result of brief mechanical excitation of the animal. With the increase in body length of Eurycercus lamellatus from 0.8 to 2.9 mm, the length of the heart increases from 110 to 350μ. During this growth period the relative length of the heart (as a proportion of the body length) decreases from 15 to 11%. Since the heartbeat rate decreases slightly during this period, the rate of circulation and metabolism apparently decreases with age. Gas exchange in the internal organs is maintained by contractions of the heart, which distributes blood oxidized in the epipodites. The surface of the epipodites is of the same order of magnitude in all Chydoridae examined.

Chydoridae have morphological and physiological adaptations which enable them to breathe at the bottom. Since their heart rate is comparable to that of other Cladocera (Smirnov, 1965d), the Chydoridae had to develop other adaptations for respiration in the benthos.

Hemoglobin was found in the hemolymph of Chydorus sphaericus by Fox (1955), who noted that the hemoglobin content of this species increases with a decrease in the oxygen content of the medium. Hemoglobin was not found in other Chydoridae. However, it may be assumed that considerable concentrations of hemoglobin are present in many of these bentho-pelagic species, which are exposed to frequent deficiencies of oxygen. Chydoridae living in decomposing silt often show a pink coloration. During cultivation of Chydoridae on decomposing plants, a reddish tinge appeared even in species which usually do not have such a coloration (e.g., Pleuroxus striatus, P. trigonellus, and P. truncatus).

Some authors considered the reddish coloration as a specific character (e.g., P. E. Müller (1867) when he described Alona sanguinea (syn. A. quadrangularis)). However, the data available demonstrate the instability of this character, which is caused by a direct adaptive increase in the concentration of hemoglobin in response to a lowering of the oxygen content. Hemoglobin was found in many species of the genera Eurycercus, Chydorus, Pleuroxus, Alonella, Alona, and Acroperus collected in the littoral of the Rybinsk Reservoir or grown in cultures.

115 We proved the presence of hemoglobin in a number of species by the formation of pyridine-hemochromogen crystals after Hoshi (1963 : 88). The crustaceans were placed on a glass slide, water was removed with filter paper, and drops of a solution consisting of 3 parts 10% $NaHSO_3$, 3 parts pyridine, and 10 parts 30% glucose were placed on the specimens. A cover glass was then placed on the animals. It was possible to see crystals in a few minutes mainly on the dorsal margin and in the epipodites. The crystals were red violet and of characteristic form. Blood of crucian carp in which numerous such crystals were formed was used as control. Hemochromogen crystals were obtained in Eurycercus lamellatus, Pleuroxus trigonellus, P. striatus, P. truncatus, Biapertura affinis, and Acroperus harpae. Crystals were not obtained in the yellowish species Pleuroxus aduncus, Disparalona rostrata, Alonella excisa, Chydorus sphaericus, and Pseudochydorus globosus, or in the colorless Alona rectangula and Graptoleberis testudinaria.

TABLE 10. Rate of heartbeat of replete crustaceans, number of beats per minute at 17—18° C

Species	Average body length, mm	Excited	Resting	Length of heart as percentage of body length
Females				
Biapertura affinis	0.84	350	310	10.5
Alona costata	0.505	320	300	9.60
A. guttata	0.343	270	210	9.85
A. rectangula	0.33	260	240	9.48
Disparalona rostrata	0.43	340	190	10.45
Camptocercus rectirostris	0.87	330	280	9.44
Chydorus gibbus	0.49	350	290	12.27
Ch. sphaericus, ephippial	0.57	370	230	17.21
Eurycercus lamellatus	0.77	350	280	14.0
E. lamellatus	2.6	320	310	12.4
Graptoleberis testudinaria	0.51	270	240	9.36
Monospilus dispar	0.44	260	210	9.88
Pleuroxus aduncus	0.59	330	290	13.8
P. striatus	0.635	330	260	12.6
Males				
Acroperus elongatus	0.55	370	340	8.7
A. harpae	0.57	340	270	10.06
Biapertura affinis	0.67	360	320	11.37
Alona costata	0.37	250	210	9.2
A. guttata	0.29	250	190	8.3
A. rectangula	0.32	270	250	10.6
Chydorus gibbus	0.45	320	300	10.44
Pseudochydorus globosus	0.60	290	290	16.00
Chydorus sphaericus	0.42	310	260	15.53
Eurycercus lamellatus	1.1	340	330	14.75
Monospilus dispar	0.38	240	240	10.3
Pleuroxus uncinatus	0.51	330	320	13.92

After finding hemoglobin in Chydoridae and particularly in the pink Pleuroxus trigonellus, we demonstrated its existence by another method, i. e., by the formation of hemin crystals after Hoshi (1963 : 94). However, we took whole animals rather than the liquid extracted from them as in Hoshi's method. P. trigonellus was dried on a glass slide and treated with a drop of NaOH solution and then covered with a cover glass. A few drops of glacial acetic acid were then introduced under the cover glass. The preparation was heated until the acetic acid began to boil. Another drop of glacial acetic acid was then placed under the cover glass. Violet crystals of hemin of characteristic form appeared in the body of P. trigonellus when the preparation cooled, i. e., within about one hour.

We also proved the presence of hemoglobin in Chydoridae by staining blue with benzidine base after Pearse (1962:864–865). The specimens were dried and treated for 10 minutes with a solution containing 15 ml methanol, 116 0.2 g benzidine, and a sodium nitroprusside crystal about 5 mm^3 large. The animals were then washed with ozonated ether (25 ml 3% H_2O_2, 50 ml methanol, 25 ml ether) and finally washed with water. After this treatment, a blue color appeared in Acroperus harpae (heart region, keel) and in Pleuroxus truncatus (postabdomen). This coloration is best seen in incident light under the binocular microscope. P. trigonellus, which contains a large quantity of hemoglobin (according to the red coloration and the formation of hemochromogen and hemin crystals), became stained brown with benzidine. A brown color was also obtained in Biapertura affinis and Eurycercus lamellatus. The benzidine method apparently detects lower concentrations of hemoglobin and is suitable for crustaceans without a distinct reddish coloration.

We found no reddish coloration in Rhynchotalona falcata and Monospilus dispar, which live in the littoral without vegetation. Analysis of the function of the legs of these species showed that their epipodites do not make rhythmic movements as in other species for pumping water to wash the gills (Smirnov, 1968). This is probably due to the fact that these species inhabit the open littoral and the oxygen regime here is more favorable than in the overgrown zone; these forms cannot live where there is vegetation, since the oxygen is absorbed by decaying organic matter.

FUNCTIONAL COMPLEX RESPONSIBLE FOR THE PROTECTION OF THE BODY AND FOR THE SUPPORT OF OTHER ORGANS

The epithelium of the integument and the chitinous layer secreted by it belong to this complex.

The relatively strong chitinization of the Chydoridae is not surprising because they live in an environment which contains abundant organic and mineral particles of varying hardness and the body therefore requires protection. The antennules with their delicate sensory papillae and setae are protected by the overhanging rostrum. The rostrum may be short and blunt or long and pointed. The protective role of the long, recurved rostrum of Rhynchotalona falcata is quite evident in the environment of this species, which lives among silt particles on the bottom of the bare littoral; the rostrum protects the antennules anteriorly and from below.

The body of the Chydoridae forms a bend between the abdomen and postabdomen. Despite the general loss of segmentation, several segments can be recognized in the abdomen near this bend. This region has a specialized musculature. The dorsal part of these segments is strongly chitinized. The articulation of the Chydorinae and Aloninae consists of chitinous structures. The abdominal wall of Acroperus, Camptocercus, and Monospilus also contains chitinous supporting elements (Figures 14–24).

The Chydoridae undergo up to 48 molts during the lifespan. The molts involve the shedding of the entire integument including the chitin of the segmented appendages. The exuviae retain all external characters and can be used for studying the external morphology. In our experiments, the stages of Eurycercus lamellatus lasted 24 hours at 16° C; the 6th stage lasted 2 days at 18–23.5° C. According to Storch (1926), the interval between the early molts is 4 days and increases later to 8–9 days. Camptocercus rectirostris molts every 48 hours.

Rammner (1928) found that each stage of Chydorus sphaericus lasts about 3 days. In Pleuroxus trigonellus, the interval between molts is 2–3 days between the first two molts but later increases to 3–4 and 5 days. According to Cheremisova (1958), that interval between the first and second molt of Chydorus sphaericus is 2 days at 18–23.5° C. We observed a repeated production and deposition of ephippia in Eurycercus – up to 8 times at intervals of 2 days (sometimes one day) until death. The ephippia were formed in the absence of males. The valves are not shed in the molt of Acroperus elongatus, and 1–2 such valves may be present in addition to the main valve (Brady, 1868;421, Figure 8). In Monospilus dispar this phenomenon is quite normal, but specimens with a single shell occur in the fall. Specimens of Acroperus elongatus with 2–3 superimposed valves occur frequently together with individuals with a single valve (Ivan'kovo and Uglich reservoirs). Indications of this can be found in Lilljeborg (1900), Vereshchagin (1913c), and Herbst (1955). It should be mentioned that Monospilus dispar and Acroperus elongatus are bottom dwellers. In A. elongatus, where the valves are not shed, the postabdomen appears first and makes sporadic jerks to tear the exuviae which cover the legs. The number and frequency of molts during the lifespan are given in Table 11 (after Smirnov, 1965c). In all the Chydoridae examined there are only a few molts during the period of rapid growth. Most molts take place at a time when growth has practically ceased. The regular occurrence of molts without growth is apparently associated with the continued production of young throughout the life span, since these two phenomena are interrelated in the Chydoridae. Molts, however, also take
118 place when the brood pouch is empty. Rammner (1929) found that there is an interval of about 4 hours between the production of progeny and the molt of Chydorus sphaericus during which the female swims, feeds, and defecates. An egg enters the brood pouch 15 minutes after the molt. Swi Swimming is resumed about half an hour after the molt. In our experiments, Acroperus harpae molted daily at the beginning of life and on alternate days from the 10th day of life onward. The molt of the Chydoridae almost coincides with the birth of the progeny, but the number of molts is usually greater than that of batches of progeny (in addition to the molts before maturity). The frequent molts which take place without growth during the

TABLE 11. Life cycle of Chydoridae after experimental data

Species	Individuals reared	t, °C	Duration of embryogenesis, days	Duration of development from hatching to appearance of eggs in brood pouch, days	No. of molts until first appearance of eggs in brood pouch	Length of life, days (maximum values in parentheses)	No. of molts during life (maximum values in parentheses)	No. of batches of progeny during life (maximum values in parentheses)	No. of progeny during life (maximum values in parentheses)	Length of young as percentage of body length of mother
Acroperus harpae	4	17–24	2	3	2	34–74(82)	10–29(48)	10–22(31)	14–42(62)	60
Biapertura affinis	10	14–20	2–5	4–5	1?	37–61(68)	7–14(15)	9–13(16)	17–25(32)	50
Alona costata	6	15–22	2–7	3–5	2	29–94(140)	10–19(34)	4–10(14)	8–20(28)	60
A. quadrangularis	4	22–24	2	4	1?	36–45(56)	7–10(16)	9–10(18)	17–20(36)	57
Camptocercus rectirostris	4	22–24	4	3	2	20–22(46)	–	6– 7(11)	12(22)	78
Pseudochydorus globosus .	–	–	–	–	–	–	12–26(30)	–	–	63
Chydorus sphaericus	18	14–22	2–7	3	2	40–87(99)	7–20(21)	8–22(27)	15–44(54)	47
Ch. sphaericus (in the dark) .	16	15–22	2–10	2–5	2	29–74(80)	3– 6(14)	3–17(18)	6–34(35)	–
Eurycercus lamellatus ...	7	16–18	3	10	3	15–25(38)	–	2	14	26
Graptoleberis testudinaria	–	15–16	3	5	–	–	–	–	–	53–64
Oxyurella tenuicaudis (after Chorik, 1964)	–	16–25	–	–	–	37	6–11(17)	–	–	–
Pleuroxus aduncus	17	14–20	3–6	4	2	32–55(68)	6–16(18)	4–10(6)	6–12(20)	61
P. striatus	16	14–20	3–6	5	2	34–65(77)	5–15(16)	3–11(14)	4–20(26)	58
P. truncatus.............	17	14–20	2–7	4–6	1	31–64(100)	–	6–14(17)	11–28(33)	57–64
Anchistropus emarginatus (Borg, 1935a, 1935b, 1936)	–	–	3	7	2	–	–	–	–	50

greater part of life may be due to the intensive growth of algae and Protozoa on the crustacean in the littoral (the legs also become overgrown; Figures 177 and 178).

Specially modified valves envelop the resting eggs and are deposited together with them, forming a primitive ephippium which is characteristic for the Chydoridae (Figures 157 and 158).

FUNCTIONAL COMPLEX RESPONSIBLE FOR REPRODUCTION

The performing part of this complex is the gonad together with the brood pouch of the female and the male postabdomen, which serves as a penis. The existence of the perceiving part can be inferred from the lowering of the heart rate in copulating Chydorus sphaericus.

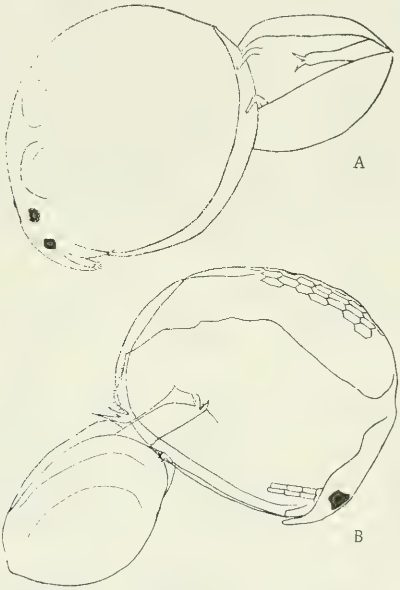


FIGURE 154. Copulation:

A — Chydorus sphaericus (Rybinsk Reservoir, 21 September 1962); B — Monospilus dispar (Rybinsk Reservoir, 30 September 1963).

Males are smaller than females and also wider. The external structures of the sexes show differences which can be explained in terms of the sexual function. The sexual dimorphism of the valves and head shield of the males can be understood from the spatial and functional relationships between the sexes during copulation (Figure 154). The male uses the hooks of legs I to hold the female so that the apex of the hook is situated below the margin of the valve of the female. The form of the hook differs slightly in the different species. It has a rugose apex and sometimes bears denticles on

the concave side. The holding of the valve of the female is helped by the fact that the outer ramus of the endite bears a brush of strong setae opposite the apex of the hook which are directed toward the distal end of the legs. The valve of the female may bear a sculpture which prevents the brush from sliding off. The sculpture is therefore more developed at the periphery than in the central part. Copulation is prolonged and the female can swim while carrying one or even two attached males. The anteroventral corner of the valve of the male is markedly incised, since the male adheres to the convex valve of the female during copulation (e.g., in Chydorus sphaericus and Euryalona). The head shield also shows sexual dimorphism (Figure 155). If the rostrum is elongate, it is much longer in the female, while that of the male is short and blunt. Observations of copulating crustaceans explain the spatial relationships between the sexes during copulation. While the male is attached to the valve of the female its rostrum is in contact with the convex surface of the body of the female. Even if it is short, the rostrum of the male rests on the valve of the female and the space between the rostrum and the anterior side of the valve can only contain the antennules, which
119 palpate the surface of the valve of the female. The antennules of the male project beyond the apex of the rostrum; they bear accessory setae and often accessory papillae directed toward the valve of the female. The antennules of the male reach much closer to the apex of the rostrum or protrude farther beyond it than those of the female. The valves of the Chydoridae have varying surfaces, from perfectly smooth to deeply honeycombed. The structures of the functional complex for attachment to the substrate are modified in the male because of the need for attachment to the valve of the female.

(120) TABLE 12. Minimum size of eggs of Chydoridae

Species	Length × width	Reference
Eurycercus glacialis.......	552 × 550	Green, 1966
E. lamellatus	329 × 259	Green, 1966
Pleuroxus aduncus.........	125 × 70	Our data, after fixed material
P. truncatus (length 0.65 mm) . . .	173 × 110	After live material
Alonella excisa...........	100 × 58	After fixed material
A. exigua	90 × 48	After fixed material
Pseudochydorus globosus (length 0.57 mm)	290 × 181	After live material
Biapertura affinis.........	220 × 124	After fixed material
Acroperus harpae	140 × 82	After fixed material
A. elongatus	170 × 85	After fixed material
Camptocercus rectirostris . .	200 × 109	After fixed material
C. lilljeborgi	180 × 110	After fixed material

Fertilization involves the introduction of the markedly modified postabdomen of the male below the valve of the female (Figure 154). The postabdomen of the male changes with age: it resembles at first that of the female, but later loses the anal denticles and assumes the appearance characteristic of the male postabdomen; at the same time the opening of
120 the vas deferens is displaced distally (Figures 213 and 214). The postabdomen of adult males is narrower than that of adult females. It has no

distinct anal denticles, the presence of which is incompatible with copulation. For the same reason, the preanal corner of the postabdomen of the male protrudes less than in the female (Figure 213). From the functional point of view, the changes in the males with age are such that the rapid growth in early life is sustained by the same feeding and locomotory apparatus as in the females. The postabdomen assumes male characters later in life, when growth practically ceases and the crustacean produces only exuviae and sperm. This is a division in time between the trophic and sexual functions, the former being responsible for the plastic and energy metabolism in the young male, but later mainly for the energy metabolism.

(119)

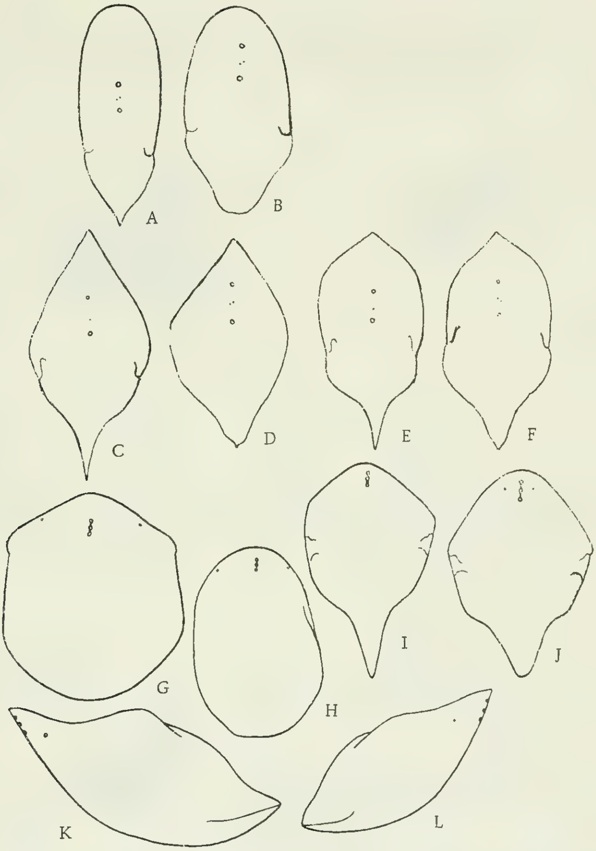


FIGURE 155. Sexual dimorphism of the head shield:

Chydorus sphaericus: A — female, B — male (Rybinsk Reservoir, 16 October 1965); Pleuroxus trigonellus: C — female, D — male (after Frey, 1962a); P. uncinatus: E — female, F — male (after Frey, 1962a); Acroperus elongatus elongatus: G — female, H — male (Rybinsk Reservoir, Borok, 16 October 1965); Kurzia latissima: I — female, J — male (after Frey, 1962a); Acroperus harpae: K — female, L — male.

If females are present, the males show a marked tendency to attach themselves to the valves of other specimens. We observed a female of Chydorus sphaericus (30 October 1964) with two males attached. Each of the males carried another male, attached to the valve by the hooks of leg I. The male clasping the left valve later fell off, and a third male joined one of the two males attached to the right valve (clasping the left valve), so that there was a chain of three males. Finally, a fourth male joined the middle one of the males at the right valve, on which a male was already attached.

The brood pouch of the female Eurycercus lamellatus changes markedly during growth; the dorsal process of the abdomen is absent in young specimens (Figure 82).

Primitive Chydoridae develop numerous eggs at one time. The larger species produce larger eggs (Table 12, Figure 156). The relationship between length of egg and length of body is shown in Figure 156. The Chydorinae and Aloninae develop two young at a time, but the size of the young resembles that of the adults more closely. If feeding is insufficient, the brood pouch may remain without eggs for a long time and numerous molts may take place without the production of progeny. It is interesting that forms which produce few eggs are not necessarily rare; on the contrary, Chydoridae with a low fertility may have a high density. The density of Eurycercus lamellatus does not exceed 60,000 organisms/m^3 in nature or in cultures. Saycia cooki, which produces numerous eggs, is extremely rare. The maximum density of Chydorinae is about one million organisms/m^3 in nature and in cultures. The number of eggs produced by a single female of Eurycercus lamellatus shows seasonal variation. In England this number is lowest in January and highest in April, and the number of eggs is directly proportional to the length of the female (Green, 1966). Data from the Rybinsk Reservoir are given in Figure 180. The Chydoridae are represented by parthenogenetic females during the greater part of the vegetation period. The brood pouch of those Chydoridae which
124 produce two young at one time sometimes contains a single egg, rarely three eggs. Males and females with eggs ready for fertilization appear under adverse conditions. Fertilization results in the formation of resting eggs in a primitive ephippium (Figures 157 and 158). The ephippia of Chydoridae sink to the bottom and do not float like those of the planktonic Moina. The female E. lamellatus glue the ephippia to plants (Makrushin, 1967).

The resting eggs develop into females. When hatching from the latent egg, Pleuroxus uses the claws of the postabdomen to tear the yolk membrane (Shan and Frey, 1968).

The numerous eggs in the brood pouch require good aeration; this is achieved in Eurycercus lamellatus by the process on the dorsal side of the postabdomen. There is no such process in the Chydoridae which develop two eggs at a time.

Rammner (1933a) incubated eggs of E. lamellatus outside the brood pouch. He assumed therefore that egg development in this case does not require nutrient liquid in the brood pouch. Green (1961) also found that eggs of Chydorus can develop outside the brood pouch.

The concept of periodicity is connected with the periodical appearance of males. One cycle consists of the period of parthenogenetic reproduction

(121)

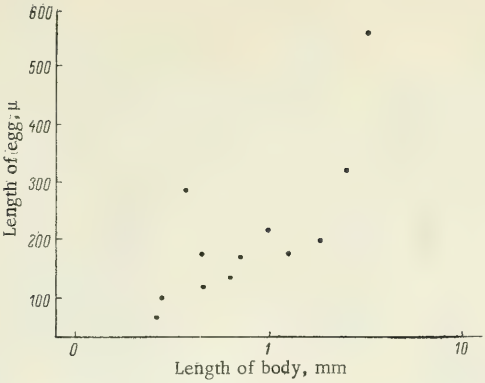


FIGURE 156. Relationship between body length and length of parthenogenetic eggs (according to data of Table 12)

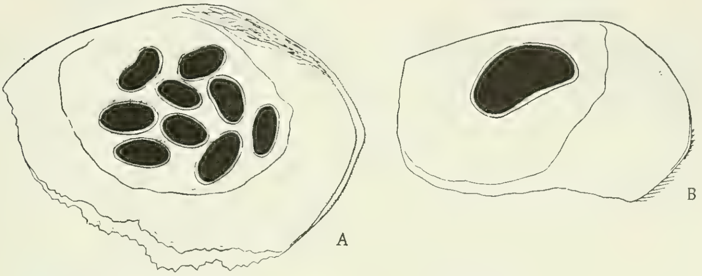


FIGURE 157. Ephippia:

A — Eurycercus lamellatus, length of egg 220 μ (Rybinsk Reservoir, Borok, 2 October 1962, preparation 1163); B — Biapertura affinis, length of egg 250 μ (Rybinsk Reservoir, Borok, 2 October 1962, preparation 1167). (Not drawn to scale.)

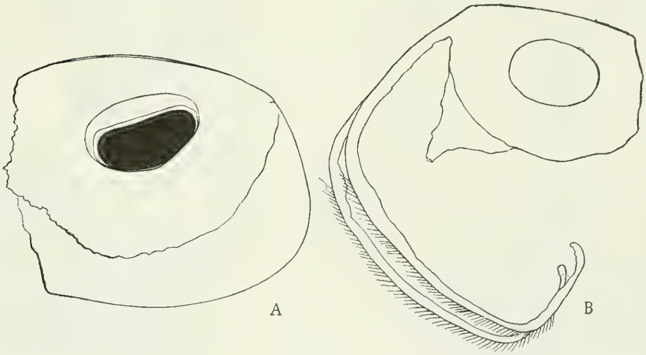


FIGURE 158. Ephippia:

A — Tretocephala ambigua, length of egg 260 μ (Lenkoran' district, Mashikhanskii Pond, 25 May 1963, preparation 1226); B — Leydigia acanthocercoides (after Scourfield, 1899).

(122)

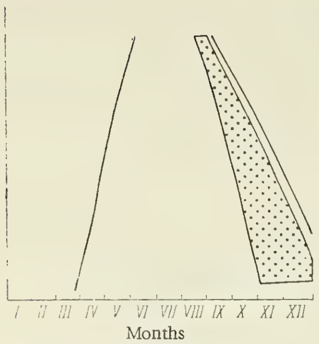


FIGURE 159. Periodicity of Oxyurella tenuicaudis (after Vereshchagin, 1912c) according to duration of vegetation period:

The dotted area indicates the sexual period. The lines at the sides indicate the period of active life. Abscissa — month; ordinate — latitude.

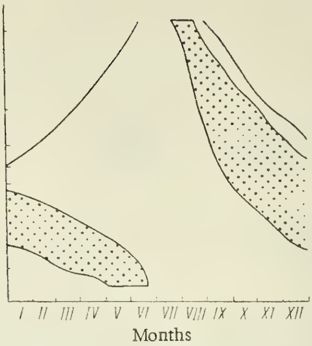


FIGURE 160. Periodicity of Alona quadrangularis (after Vereshchagin, 1912c). Legend as in Figure 159.

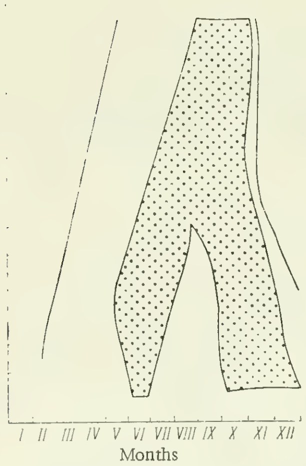


FIGURE 161. Periodicity of Pleuroxus truncatus (after Vereshchagin, 1912c). Legend as in Figure 159.

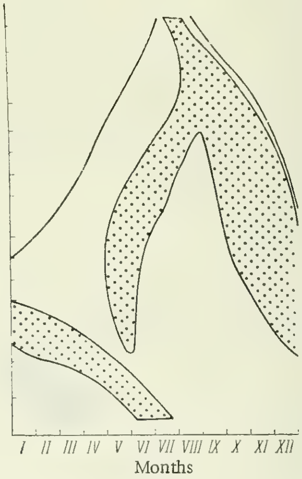


FIGURE 162. Periodicity of Chydorus sphaericus (after Vereshchagin, 1912c). Legend as in Figure 159.

(123)

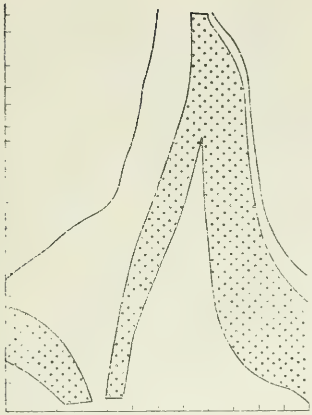


FIGURE 163. Periodicity of Biapertura affinis (after Vereshchagin, 1912c). Legend as in Figure 159.

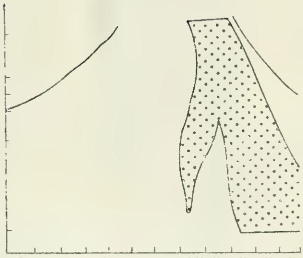


FIGURE 164. Periodicity of Leydigia leydigi (after Vereshchagin, 1912c). Legend as in Figure 159.

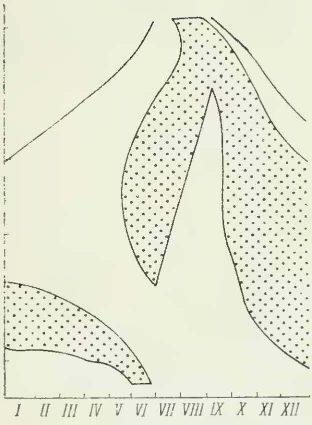


FIGURE 165. Periodicity of Eurycercus lamellatus (after Vereshchagin, 1912c). Legend as in Figure 159.

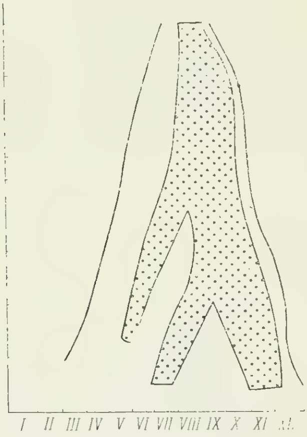


FIGURE 166. Periodicity of Alonella excisa (after Vereshchagin, 1912c). Legend as in Figure 159.

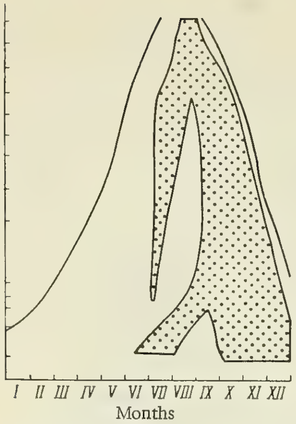


FIGURE 167. Periodicity of Acroperus harpae (after Vereshchagin, 1912c). Legend as in Figure 159.

together with the following period of bisexual reproduction. Vereshchagin (1912c) used graphs which show the existence of parthenogenetic and sexual generations of Chydoridae in relation to the vegetation period (latitude of the area) and established that there were several types of periodicity. If there is a single period of bisexual reproduction, the population is monocyclic. Oxyurella tenuicaudis and Alona quadrangularis are monocyclic in a wide range of vegetation periods (Figures 159 and 160). In Pleuroxus truncatus, Biapertura affinis, Leydigia leydigi, Chydorus sphaericus, and Eurycercus lamellatus the single cycle is divided in areas with a longer vegetation period so that there are two periods of bisexual reproduction, i. e., two periods in which males are present (Figures 161–165). In areas in which the vegetation period is short, the female Chydorus sphaericus developing from ephippial eggs can produce females and males, and develop ephippial eggs after fertilization (Olofsson, 1918). In Leydigia leydigi, the first cycle lasts much longer than the second. If the vegetation period lasts longer, the first bisexual cycle disappears and a secondary monocyclic cycle begins. When the vegetation period becomes longer, Alonella excisa shows a transition from a monocyclic to a dicyclic cycle, then to a polycyclic cycle; one of the cycles then disappears and it becomes secondarily dicyclic (Figure 166). Acroperus harpae becomes dicyclic from monocyclic and finally secondarily dicyclic (Figure 167). The periodicity is further complicated by the fact that all individuals of a population do not necessarily enter the sexual period in each cycle.

Some stages of embryogenesis are shown in Figures 168–170. Of particular interest is the length of the fully developed embryo of Pseudochydorus globosus and Acroperus elongatus.

Chydoridae reproduce intensively when cultured on detritus, and no ephippia develop under these conditions even shortly before death. Males and ephippial females appear in late August in the Rybinsk Reservoir. Konstantinova (1957) found that the number of batches of progeny produced by Chydorus sphaericus increases in the first 15 days of life and decreases in the last 15 days. Kurz (1875) induced the development of males by drying the aquarium containing the females. Wicks were placed on the margin of the aquarium and water was gradually taken up by capillarity. In 14 days the water in the aquarium became reduced by a factor of 6–8 and males of Eurycercus lamellatus, Alona quadrangularis, and Leydigia leydigi appeared (in early summer!). Male Chydorus sphaericus (5.5% of the young) appeared after prolonged maintenance of the culture at 8–10° C, or an increase in the population density to 500 organisms per liter (8.7%) (Mortimer, 1936), or if the food of females with developed eggs was stopped.

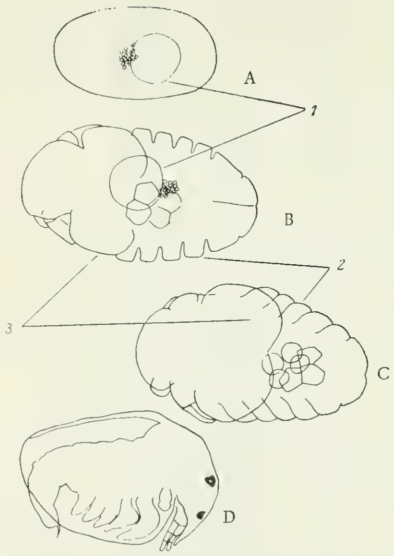


FIGURE 168. Some stages of embryonic development of Pleuroxus aduncus aduncus (Il'd River, 10 August 1962):

A — egg, length 125 μ, preparation 390; B — preparation 1049; C — preparation 726; D — preparation 730. 1 — oil droplet; 2 — rudimentary legs; 3 — rudimentary valves.

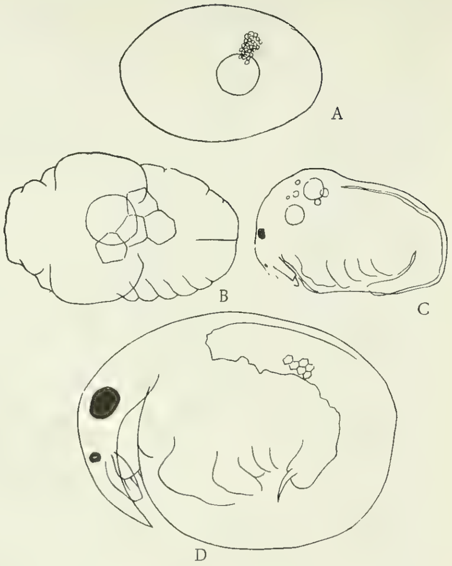


FIGURE 169. Some stages of the embryonic development of Pseudochydorus globosus globosus (Cherepovets Reservoir, above Goritsa, 16 September 1963):

A — length of egg 210 μ, preparation 660; B — preparation 663; C — preparation 673; D — preparation 669.

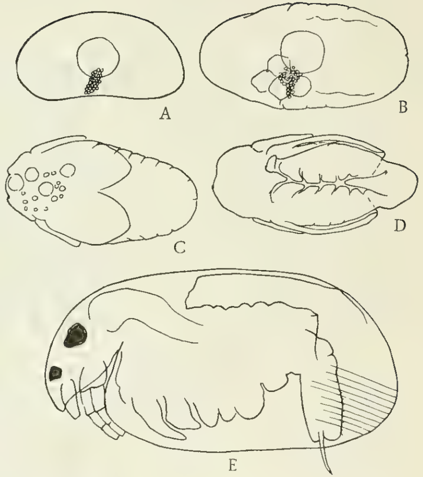


FIGURE 170. Some stages of the embryonic development of Acroperus elongatus elongatus (Uglich Reservoir, 23 July 1962):

A — egg, length 170 μ, preparation 538; B—preparation 528; C — preparation 621; D — preparation 521; E — preparation 626.

(126)

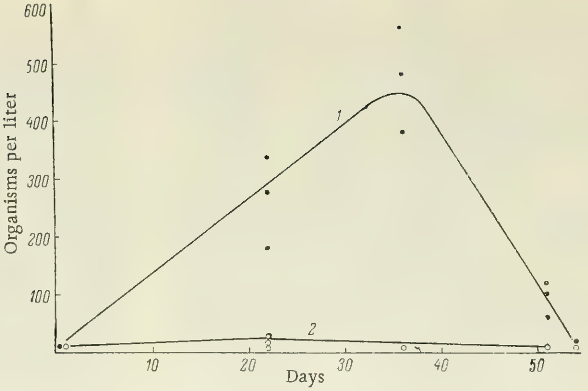


FIGURE 171. Development of a culture of Pleuroxus striatus: 1 — without additional specimens; 2 — in the presence of Limnaea stagnalis.

Jurine (1820) and Konstantinova (1957) succeeded in breeding Chydorus sphaericus throughout the life span. Jurine (1820) observed 9 batches of young during the life of Alona quadrangularis ("striatus"); the embryonic development of this species lasts 1 to 5 days. In order to obtain quantitative data on the life cycle of the Chydoridae, we reared them from clones throughout life (Smirnov, 1961a, 1962a, 1965c). The life, reproduction, and normal activity of most Chydoridae could be maintained by feeding them on filtered detritus. Only Eurycercus lamellatus failed to attain its normal size and produced a reduced number of young in these conditions. Feeding with green or blue-green algae or with an infusion of aspen or birch leaves killed all the Chydoridae examined in a few days (Daphniidae, on the other hand, reproduced well on aspen or birch leaves). The specimens were kept separately in dishes of 3—4 ml capacity, in which they could be observed with the binocular microscope. After each molt, or in case of delayed molt, they were transferred to dishes with fresh detritus. The detritus was collected from the vegetation in the Rybinsk Reservoir. The culture of Chydoridae on a single batch of detritus in vessels of 0.5—1 liter capacity produced poor results. The data obtained are shown in Table 11. Embryonic development lasted 2—3 days at room temperature, sometimes slightly longer. Development up to maturity took 2—6 days; it took 10 days in E. lamellatus.

E. lamellatus attained maturity after 12 days in containers placed in the littoral of the Rybinsk Reservoir at an average temperature of 20° C. The life of the Chydoridae examined is 2—3 months. Alona costata lived longest — one specimen lived for 140 days. The length of life was sometimes shorter, probably because of the condition of the animals, the quality of the food, and other factors. The crustaceans molted repeatedly. The greatest number of molts was observed in Acroperus harpae. They molted twice before maturity; cases with a single molt were probably due to the loss of one of the first (very small) exuviae in the detritus in which the animals burrowed.

(127)

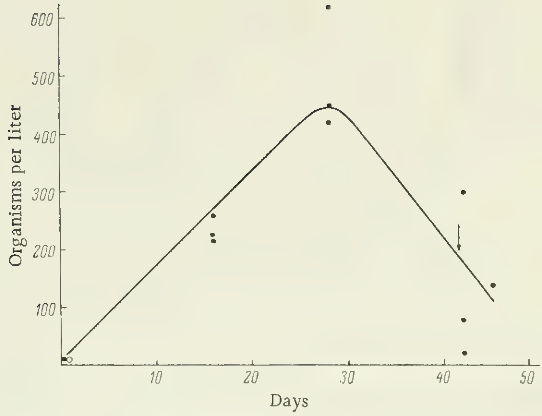


FIGURE 172. Development of a culture of Pleuroxus truncatus truncatus. The arrow indicates the appearance of males (30 June 1965).

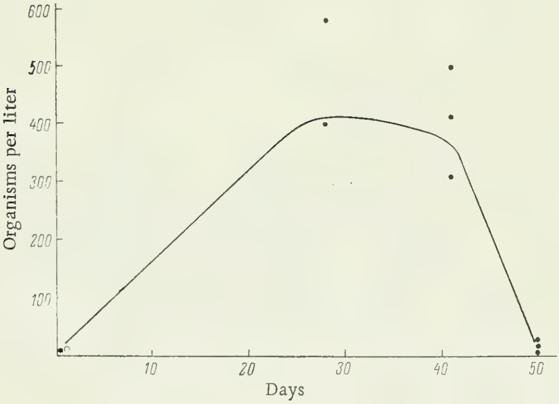


FIGURE 173. Development of a culture of Chydorus sphaericus

(128)

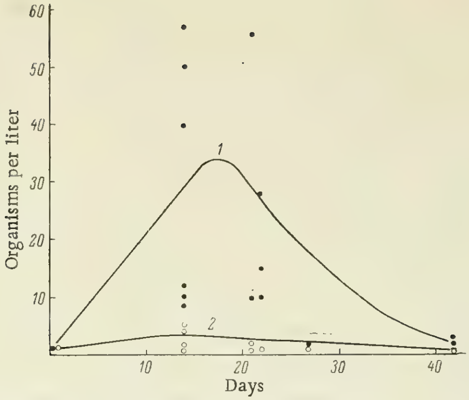


FIGURE 174. Development of a culture of Eurycercus lamellatus:

1 — without additional animals; 2 — in the presence of Limnaea stagnalis.

Growth is rapid before maturity. The growth of Chydoridae almost ceases after the first batch of young. This explains the small number of size groups in field material (about 6); the last size group consists of all the older ages. About 10 batches of young are produced during life. The largest number of batches (up to 31) was found in Acroperus harpae. This corresponds to a maximum of 62 young in A. harpae. Cheremisova (1958) observed 30 batches in 67 days in Chydorus sphaericus. Jurine (1820) observed 15 batches of young in the same species and Konstantinova (1957) an average of 20. Of particular interest is the large size of the young of these species, which have no metamorphosis (Table 11). Death under experimental conditions was usually not preceded by the formation of ephippia. Some experiments, however, ended with the formation of an ephippium. In these cases the crustaceans produced and deposited several ephippia: Alona costata up to 13, Pleuroxus striatus up to 3, P. aduncus up to 2, and Eurycercus lamellatus up to 8. Except for E. lamellatus and Pleuroxus truncatus, the formation of ephippia did not take place before August. There was never a reversion to parthenogenetic reproduction after the formation of ephippia. The number of molts was usually greater than that of batches of young, the difference was due not only to the two molts before maturity but also to the fact that some molts of mature specimens were not accompanied by the production of young.

Eurycercus, the most primitive genus morphologically, includes E. lamellatus, an abundant and widely distributed species found commonly in the vegetation. The primitive Saycia cooki, which also produces 128 numerous young per batch, is apparently rare. This species was recorded by King (1866) and Sars (1904a); we received it from Jolly, who stated that only a few females were obtained from the large amount of material examined. The subfamilies Chydorinae and Aloninae contain not only common, cosmopolitan species but also forms found only once. Highly specialized Chydoridae such as Leydigia and Camptocercus occur in restricted biotopes and produce a comparatively small biomass.

Cultures containing macrophytes, filamentous algae, and silt may be considered as an imitation of the natural environment. Marked pollution, however, rapidly kills the crustaceans. Such a culture showed parthenogenetic reproduction, followed by the appearance of males. Under these conditions Pleuroxus striatus, P. truncatus, and Chydorus sphaericus attained a maximum density of about 480 organisms per liter (1 organism/20 ml) on about the 30th day (from an initial density of several organisms per liter; Figures 171–173). In the experiments of Mortimer (1936) with a culture of Chydorus sphaericus, males appeared when the culture attained a density of 500 organisms per liter. Eurycercus lamellatus reproduced badly in a similar culture; after 14 days, the density did not exceed 60 organisms per liter (i. e., 1 organism per about 150 ml; Figure 174). In the case of E. lamellatus and in other Chydoridae, the maximum densities obtained correspond to the maximum densities observed in nature (Smirnov, 1963a). In parallel cultures, Chydoridae were grown together with Limnaea stagnalis L. All cultures were kept in jars of capacity 0.5 liter or more at 16–19° C. The density of the snails was 0.5 organisms per liter (1.5 g live weight per liter). The presence of snails invariably killed the Chydoridae or suppressed their reproduction (Figures 171 and 174), apparently by creating a deficiency of oxygen. Bogatova (1963) cultured Chydorus sphaericus to a density of 6,000 organisms per liter on yeast or on an infusion of horse manure.

MORPHOFUNCTIONAL TYPES OF CHYDORIDAE

In the Chydoridae examined we found three morphofunctional types of the leg apparatus which differ with respect to the pump chamber.

The first type (actively filtering, short legs) is found in Chydoridae with a relatively short body and with legs situated close together; the posterior legs are apparently inserted between the anterior legs. In forms with a very short body (Chydorus, Pleuroxus), the exopodites of legs IV and V are situated so that their longitudinal axis forms a sharp angle with the longitudinal axis of the body. The anterior setae of the exopodites of legs IV and V are tactile, with sparse hairs. The rhythmic vibrations are performed by the exopodites of legs IV and V. A variation of this type is found in the leg apparatus of Chydoridae with an oblong body, e. g., Acroperus harpae and A. elongatus; as in the typical case, the exopodites of legs IV and V move rhythmically in these species. In the majority of Chydoridae, the ratio between the length of the filtration chamber (from the gnathobase of leg III to the apex of the feathered setae of the exopodite of leg V) and its height (from the lobes of the preepipodite to the ventral margin of the valve) is about 1.5:1. If this ratio is about 2:1, i. e., if the legs which form the third functional unit are displaced along the longitudinal axis (in Chydoridae with an oblong body), there are modifications of the form and position of the legs and in the function of the pump chamber. In A. harpae and A. elongatus, which have an oblong body, the exopodite of leg V is oblong and barely divided (it has a concave ventral side). The longitudinal axis of the exopodites of legs IV and V of these species forms a relatively small angle with the longitudinal axis of the body. The anterior seta of the exopodite of leg V is directed anteriorly (not ventrally); it is feathered and closes the gap between the exopodite and the lobe of the endite of the leg. A similar function is performed by the anterior seta of the exopodite of leg V in Biapertura affinis. The anterior setae of the exopodite of leg IV have sparse hairs and are directed toward the ventral margin of the valves (tactile setae). In Disparalona rostrata, Alonella excisa, and A. exigua, legs I–III are of about equal size although D. rostrata is much longer (0.49 mm) than the other two species (0.33 and 0.32 mm, respectively). Legs IV and V, especially their exopodites, are very large in Disparalona rostrata but not in Alonella excisa and particularly not in A. exigua. The difference in the size of the exopodites and their setae explains the different filtering capacity of the filtration chamber formed by legs III–V. The larger species shows only an enlargement of legs IV and V instead of an enlargement of all legs.

The second type of leg apparatus (actively filtering, long legs) is found in species of Camptocercus which have a very long body. The legs are not situated so closely together as in Chydoridae with a short body. The ventral side of the body has no appendages for a large distance behind the legs. The filtration chamber is longitudinal. The pump chamber, in which the exopodite of leg V serves as a pump, is also longitudinal. The exopodites of legs III and IV do not make rhythmic vibrations; they cover the pump chamber ventrolaterally. Leg III therefore closely resembles leg IV, in contrast to the condition in other Chydoridae, although these legs can be homologized with the legs of other Chydoridae by the number and arrangement of the setae.

The third type of leg apparatus (passively filtering) is distinguished by the fact that the exopodites do not make rhythmic vibrations, i. e., there is no functional pump chamber. This type is found in Rhynchotalona falcata, Monospilus dispar, and Graptoleberis testudinaria. Although the species of these genera have no functional pump chamber, they have structures which form such a chamber in other cases. The first and second functional complex of these species correspond to that of other Chydoridae. These species retain the filtration chamber of the third functional complex, which has this name because it does not function without a functional pump. Such a filtration chamber apparently prevents the food collected by leg II from escaping posteriorly. This third type is found in Chydoridae which live in the silt in the bare littoral (Rhynchotalona falcata and Monospilus dispar) or in overgrowths of plants (Graptoleberis testudinaria). A leg apparatus of the third type can be explained, and is probably caused, by an unrestricted food supply. It is interesting that the crawling G. testudinaria uses the antennae for repulsion from the substrate, in contrast to other Chydoridae. The absence of pumping of water prevents these forms from living in a vegetation with abundant silt sediments, where oxygen is markedly reduced. In fact, Rhynchotalona falcata and Monospilus dispar live on bare littoral areas, while Graptoleberis testudinaria lives on plants. In these forms we did not find a pink coloration caused by hemoglobin, which may compensate for the absence of water pumping. In this case, life in the plant-free littoral is associated with a morphological inability for breathing under adverse conditions. At any rate, this is not the only factor which connects the inhabitants of the bare littoral with this particular biotope, since rhythmic movements of the exopodites take place in other specific inhabitants of the open littoral.

SPATIAL AND FUNCTIONAL CONDITION OF THE FORM OF THE LEGS

The differences between the legs of the different species concern their form and size, the form and size of their parts, and the size, form, and arrangement of their setae. These differences as well as the characteristics of a leg can be interpreted in terms of the functional and spatial relationships between the legs themselves and with other parts of the body, particularly the ventral margin of the valve. The strong chitinization of the setae on the outer ramus of the endite of leg I corresponds to their function (attachment to and moving on the substrate). There are three such setae, the minimum number for a stable fixation of an object. These setae differ in length, and the differences vary in the different species. The different length of the walking setae is due to the fact that most Chydoridae 130 move on a convex substrate. The inner seta must therefore be the smallest. In most Chydoridae, the inner seta is indeed more or less shorter than the others. The exopodite bears thin, sparsely feathered, and weakly chitinized tactile setae. One of these setae is very long and palpates distant parts of the substrate, while the other seta is short and palpates the substrate close to the point of attachment of the walking setae. The outer ramus of the endite and the exopodite are independently mobile in accordance with their function; this is reflected morphologically in the presence of deep grooves which separate the above parts from the stem of the endite, so that there are apparently separate segments. The rami of leg I move independently or together with the movements of the stem of the endite of leg I. When the crustacean finds a suitable substrate, leg I moves slightly forward, the distal part of its endite moves slightly between the valves, and the walking setae of the outer ramus of the endite become fixed to the substrate. Leg I has not only a musculature which moves this leg as a whole, but also a musculature for its different parts. This explains the thickness and large size of this leg, properties which are also associated with the functions of the leg and with the large and different functions of its parts.

Leg II, which collects the food, is more strongly chitinized than the other legs. This refers not only to the stem of the endite but also to its setae. The setae which scrape the food differ in length. The gnathobase of leg II is directed medially and dorsally; the setae nearest the gnathobases are situated on the approximated parts of the endites and are therefore shorter. The setae closest to the exopodites (i. e., the outer setae) are long and apparently prevent food particles falling off. The middle setae of the endite, if present, are the thickest and may form a comb. The inner ramus of the endite of leg I bears soft feathered setae and prevents food falling off. The inner anterior seta is sparsely hairy and directed ventrally toward the ventral margin of the valve (tactile seta). In the primitive Eurycercus lamellatus, the row of chitinized setae on the endite is accompanied by a parallel row of soft setae which Fryer (1963b) considers as tactile. We found a similar row of soft setae in E. glacialis. In the even more primitive Macrothrix, the row of chitinized setae on the endite ends on the side of the gnathobase in a sensilla (chemoreceptor). Such a sensilla is never present on leg II of the more specialized Chydoridae; its function is performed by the chemoreceptors of leg III.

The length and feathering and the direction of the feathering and the arrangement of the setae which form the filtration chamber of legs II—V can be interpreted in terms of function and spatial relationships. The sensillae of legs III—V, which are chemoreceptors, are situated on the inner side of the endites in the path of the food. Some setae of the gnathobases and endites are possibly tactile. Leg III moves together with leg II, suggesting cooperation of the endites of these legs in the collection of food. The movements of legs I and II are not rhythmic. The pump chamber is closed anteroventrally by the exopodite of leg III with its setae (in Camptocercus, the exopodite of leg IV also has a strictly formative function). The exopodite of leg III is situated slightly obliquely to the ventral margin of the valve. The dorsal seta on the posterior side of the exopodite is therefore the longest, the other setae are shorter. The setae on the dorsal side of the exopodite close the space between legs III and IV and are therefore relatively short. The seta situated closest to the epipodite is directed dorsally and closes the space longitudinally; this seta is therefore longer than the others on the dorsal side of the exopodite. The length of the setae on the posterior side of the exopodite of leg III and directed toward the ventral margin of the valve depends on the angle at which the seta is directed toward the ventral margin.

The exopodites of legs IV and V of Chydoridae with a pump chamber of the first morphofunctional type are large and bear large, feathered, posterior setae which increase the filtering area markedly. The anterior setae are smaller, their length being restricted by the ventral margin of the valve. In Acroperus and Biapertura affinis, the anterior setae of the exopodite of leg V close the space between the exopodite and the lobed endite; these setae are feathered and their length is restricted by the small width of the space.

The exopodite of leg IV of Chydoridae with a pump chamber of the second morphofunctional type performs the same covering function as the exopodite of leg III and also resembles it in form; the considerations concerning the exopodite of leg III apply also to the exopodite of leg IV. The setae of the filtering chamber have straight setules. These setae are directed anterodorsally, and each movement of the legs therefore propels the food toward the mouth. The feathering of the setae of the pump chamber is straight and directed usually posteriorly, thus creating a water current posteriorly. The setae usually bear short proximal and long distal setules. This can be explained by the fact that the setae diverge radially, so that their distal ends are more distant from each other; moreover, most of the work is carried out by the distal parts, since the proximal parts are situated either above the exopodites of the following legs or below the setae of the exopodites of the preceding legs. On the exopodite of leg III of Pseudochydorus globosus we found reverse feathering of the large seta closest to the epi-
131 podite (Figure 74). If it enters the pump chamber, this seta is directed anteriorly, in contrast to the other setae. According to the function of this seta, its setules have a reverse position (permitting a water current to the posterior margin of the valve). The wide, lobed, hairy endite of leg V closes the gap between the endite and exopodite of leg IV. Although uniform in function, the pump chamber shows a wide morphological variation. This explains the great diversity of legs III—VI which form this chamber.

The pump chamber of the Chydoridae shows a marked suppression of the setae of the exopodite by the setae of the preceding legs; the affected setae are short or absent. A common character of all Chydoridae is the presence of a wide space between the anterior and posterior setae on the exopodite of leg V. This is caused functionally by the fact that the setae of leg IV function in this area. In some cases, the relatively small size of a seta cannot be explained by its function or by the distance to the ventral margin of the valve but is caused by suppression; the affected seta is compensated functionally by the suppressing seta (Figure 53). For example, the small size of seta 3 of the exopodite of leg IV is due to suppression by seta 4 of the exopodite of leg III; the latter seta extends in the same area and compensates functionally for the suppression. The seta of the first antennal segment may be small or absent due to suppression by the seta of the second segment. In Macrothrix, on the other hand, the seta of the first antennal segment is larger than that of the second segment.

To summarize, a number of morphological and physiological factors explain the presence of Chydoridae in the littoral: the differentiation and specialization of legs, which permits movement and feeding on a substrate; the ability of the postabdomen to move far forward and clean the complex apparatus of the legs; the adaptation for feeding on detritus by lengthening of the intestine and specialization of the enzyme apparatus. Chydoridae can overcome obstacles by repulsion and have a thick integument which protects them from damage by external obstacles and particles. Fryer (1963b) has shown that the affinity of Eurycercus lamellatus to vegetation is due to the fact that this species feeds on the overgrowths of macrophytes and is morphologically adapted for attachment to macrophytes and for the collection of food on them. Chydoridae show numerous specific morphological characters, many of which have not yet been interpreted in terms of the biology and behavior of the species. The data given here show some characters which enable the Chydoridae to live in the littoral. The main characters of the benthopelagial Chydoridae compared with pelagic Cladocera are given below.

CHYDORIDAE	DAPHNIIDAE
Ventral margin of valve less convex than dorsal margin	Ventral margin of valve not less convex than dorsal margin
Orientation parallel to the substrate so that the morphological anterior and dorsal side of the body is also functionally so	Orientation is such that the anterior end of the body is directed upward, so that the morphological anterior and dorsal side of the body is functionally the upper and posterior side
Chitinization strong, body yellowish brown	Chitinization weak, body almost colorless
Head keel sometimes present but not produced into a helmet; lateral keels present	Head keel sometimes present; it may be produced upward (forward) and posteriorly (dorsally) into a helmet. Lateral keels absent
Valve with well defined posterior margin	Posterior margin of valve rounded, produced into an apex or ending in a spine
Rostrum often long	Rostrum small
Antennules mobile, large	Antennules immobile, in form of tubercles
Eye with 28 or 10 facets	Eye with more than 10 facets
Ocellus large	Ocellus small

Legs differentiated into two functional units for moving, obtaining food, filtration, and respiration	Legs forming a unified functional complex adapted for filtration and respiration
Epipodites (gills) usually with processes	Epipodites without processes
Constant rhythmic movements performed by legs IV and V or by leg V only, or absent	All legs in constant rhythmic movement
132 Labrum almost always with well developed plate-shaped process	Labrum without plateshaped process
Mainly moving on the substrate	Swimming; sinking to the bottom only occasionally and for brief periods
Food scraped from the substrate, then filtered	Food obtained by filtration
Ventral margin of valve with a well developed row of setae	Ventral row of valve with little developed setae
Intestine forming loops	Intestine not forming loops
Caecum present at posterior end of mid-intestine	Caecum at posterior end of mid-intestine absent
Postabdomen relatively long	Postabdomen relatively short
Postabdomen bent forward almost parallel to the body	Postabdomen forming large angle with the body
Claws reach the mouth when the postabdomen is moved anteriorly	Claws not reaching the mouth
Postabdomen usually with large lateral setae	Large lateral setae on postabdomen absent
Anus situated in proximal part of postabdomen in most species	Anus situated in distal part of postabdomen

ECOLOGY

DISTRIBUTION

Most species of Chydoridae live in the vegetation. Some species, however, live in the open littoral. Some Chydoridae live close to shore and also on deeper bottoms. Chydorus sphaericus is very abundant in the littoral but large numbers are also found in open water. There are also specialized species, viz., Dadaya macrops, which lives on the surface of water, and Anchistropus, which lives on Hydra. The littoral environment of Chydoridae is characterized by mixing of water by waves, strong turbidity, and therefore low transparency. The areas of coastal vegetation have an abundant littoral phytoplankton and bacterioplankton, and contain filamentous 133 algae and surface-growing plants. The vegetation harbors a large complex of animals including predators (Table 13). The water of the littoral is rich in detritus and colloidal flakes. Rybak, Rybak, and Tarwid (1964) distinguish between four types of littoral of lakes: open (without vegetation); accessible (water movements through sparse vegetation); protected (where water currents have little access because of the dense growth); separated (isolated by dense vegetation from the pelagial and without access to waves and currents). In a study of the fauna of Crustacea of the last three types of littoral, the authors determined the distribution of the common species of

Chydoridae (Figure 175). According to our data, Chydorus sphaericus should be considered as a polyvalent species since it occurs both in the vegetation and in the open littoral. Comparison of the biomass of Chydoridae with that of other groups of invertebrates in the littoral shows that Chydoridae are one of the mass groups in the zone (Tables 13 and 15).

(132)

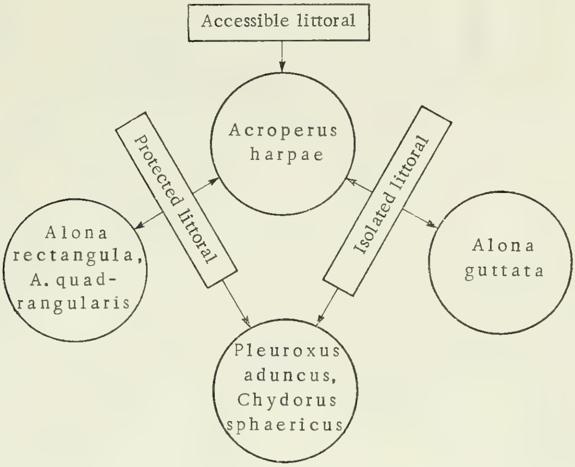


FIGURE 175. Distribution of Chydoridae in different types of overgrown littoral

133 Since Chydoridae crawl on aquatic plants and on the bottom and also swim between plants and above the bottom, we calculated the biomass as the sum total of the biomass per m^2 of bottom and per m^3 of water above the bottom; we used as unit "combined meter" (Smirnov, 1963a). Quantitative samples are accordingly taken separately from the bottom and from the water; the samples are examined separately and the data per m^2 of bottom and per m^3 of water are added.

The biomass of Chydoridae in the vegetation is many times greater than their biomass on the open bottom (Tables 13–16). A possible affinity of a species for a certain plant is concealed by the irregular distribution of
134 Chydoridae, the marked variation of environmental factors (oxygen), and accidental factors. The lack of a definite relationship between the abundance of Chydoridae and the type of vegetation is not surprising because the relationship between phytophilic Chydoridae and plants is indirect. They use plants as a substrate or are attracted by the favorable environment created by the plants. The accumulation of detritus (probably of different quality from that in nonprotected areas) and the abundant development of algae and bacteria are important factors in the life of Chydoridae.

Shcherbakov (1959) found that the number of Pleuroxus truncatus collected on stems of horsetail is 2.8 times greater than that obtained from water between the stems. No information can be obtained from the literature

(134–135)

TABLE 13. Average biomass of the phytophilic fauna in some water bodies (late July–August), in mg/combined m

Water body	Age of water body in year of study	No. of samples	Acroperus harpae	Biapertura affinis	Alona costata	A. guttata	Acroperus elongatus	Camptocercus rectirostris	Pseudochydorus globosus	Chydorus sphaericus	Eurycercus lamellatus	Graptoleberis testudinaria	Pleuroxus aduncus	P. truncatus	All Chydoridae	Sididae	Macrothricidae	Daphniidae
Cherepovets Reservoir	1 (Aug. 1963)	10	25	0.2	0.8	0	0	0.2	0.6	9	2,068	0.4	0.4	4.1	2,148	157	0, 01	29, 442
	1 (Sept. 1963)	7	59	4	4.5	0	0	0	8.4	5	1,375	4	0	6	1,406	3,810	1. 4	2, 509
	1 (Oct. 1963)	9	64	0	0.4	0	0	2	0.7	3	2,315	0.01	0	1	2.390	186	0. 06	578
	2 (Sept. 1964)	6	132	0	0	0	0	72	0.03	35	267	136	0	27	750	430	0	634
Gorki Reservoir	1 (1956)	7	0.7	0	0	0	0	0	0	1.4	1	0	0	0	3.1	0.6	0	7
	3 (1958)	3	61	0	0	0	0	0	23	0	1,363	352	0	0	1,791	6,749	0	285
	4 (1959)	3	0	—	—	—	0	0	—	—	0	0	0	0	20	471	0	561
	5 (1960)	11	0.4	16.4	0.04	0.8	10.2	8	89	14.8	248	0	0	30.6	423	2,317	0	253
	6 (1961)	5	11	5	4.5	0	54.4	0	1.1	55	694	0	10.1	147	983	173.5	0.03	748
Rybinsk Reservoir	7 (1953)	16	208.1	0	7.4	0	0	7.8	0	320.9	2,254	54.2	0	197.4	3,030.2	579.7	11.9	1,593
	10 (1956)	4	57	11	0.25	4	0	20	0	242	2,430	0	4	68	2,713	258	0	2,248
	11 (1957)	10	99.4	16.9	10.5	38	0	10	0	110	251	101	0	529	1,168	2,215	0	211
	12 (1958)	8	4,477	—	19	4	5	126	12	112	638	35	0	142	6,270	310	0	293
	15 (1961)	7	12	0.8	0	0	0	105.2	0	53.6	194	14.4	1	166.8	554	17.3	0.6	138
	16 (1962)	10	16.4	53.3	0.8	0.01	0	48.6	4	88.4	4,640	0.8	0	11.8	4,924	3,216	0.5	1.304
Uglich Reservoir	17 (1956)	13	61	210	0	176	1,377	771	54	262	598	10	0	833	3,796	12,400	5.2	1,040
	18 (1957)	4	220	0	0	0	0	0	500	0	7,619	0	0	100	9,135	4,136	0	387
	23 (1962)	20	1.8	4.7	0.5	0	29	0	0	38	40	0.4	0.04	1.7	122	2.752	0.08	134
Ivan'kovo Reservoir	20 (1956)	21	253	366	4.8	150	136	217	254	159	3,335	71.4	0	750	7,982	2,402	8.4	3,091
	21 (1957)	18	63.6	0	0	0	59.4	0	1.1	13.2	2,962	0	0	97	3,191	9.641	0	4.278
	26 (1962)	17	14.2	16	1.4	0	5.7	27.4	0.002	7.2	137.6	2.2	0	50.7	273	8,171	0	75
Sutka River	(1962)	19	5.5	2.9	0.3	0.05	0	0.4	1.1	0.6	625	0.004	1.2	12.6	653	378	0.5	92
Il'd River	(1962)	14	0.3	4.5	0.06	0.02	0	0	1.1	8.4	116	0.6	0.6	1	137	3	0.6	131
Shumarovka River	(1962)	18	0.8	2.4	0	0	0	0.5	0.9	2.4	81	0.01	1.1	5.3	98	13	0.002	136
Sunozhka River	(1962)	9	0.4	5	0.01	0.003	0	0	0.5	1.4	212	0.01	0.1	16	241	611	12	362
Ladka River	(1962)	10	0.7	2.5	0.1	0	0	2.4	0.1	0.1	35	0.2	0.02	4.8	48	57	0.6	114
Lake Poletskoe	(1964)	15	26	17	0.06	0	0	0	1	2	37	1	0	30	138	339	3	238
Lake 3 km SE of Orenburg	(1964)	1	0.4	0	0	2	0	0.5	0	5	0	0.1	0	304	317	49	0	52
Lake 7 km SE of Orenburg	(1964)	1	0	0	0	0	0	0	0	0.4	0	0.05	0	8	17	0	0	0
Pond near Pokrovka Village, Omsk Region	(1964)	1	0	0	0	0	0	0	0	11	0	0	0	0	11	0	0	40
Quarries in a swamp near Lake Poletskoe	(1964)	20	4	0	0.005	0	0	0	0	37	1	0.02	0	0.5	56	0	6	1,946

TABLE 13 (continued)

Water body	Age of water body in year of study	No. of samples	Poly-phemidae	Bosmina	All Cladocera	Ostracoda	Cyclopoida	Calanoida	Hydracarina	Chirono-midae	Rest of Insecta	Oligochaeta	Hirudinae	Gastropoda	Bivalvia	Hydridae	Total fauna (except Rotatoria and Protozoa)
Cherepovets Reservoir	1 (Aug. 1963)	10	591	7	32,345	41	331	5.2	3.2	1,579	125	4,208	0	23	0	7	38,667
	1 (Sept. 1963)	7	7	12	7,754	16	44	14	2	8,991	796	4,635	0	11,147	0	104	36,603
	1 (Oct. 1963)	9	0	0.3	3,155	1.3	29	51	0	180	98	153	0	1,214	0	0	4,880
	2 (Sept. 1964)	6	1,924	75	3,813	10	493	28	6	29	1,199	759	0	2,103	0	6.2	8,325
Gorki Reservoir	1 (1956)	7	0	5.4	16.1	0	36	0	0	33	0	0	0	0	0	0	89
	3 (1958)	3	0	0	8,825	43	544	0	0	5,869	7,303	403	1,627	9,880	0	336	34,830
	4 (1959)	3	0	16	1,068	144	266	0	597	203,920	5,245	209	41,120	5,010	0	0	257,620
	5 (1960)	11	0	0.1	2,993	814	45	0	1,122	7,965	350	0	4,232	761	0	35	18,320
	6 (1961)	5	0	2	1,907	234.6	481.8	0	153.6	109.8	79.4	86.2	0	136	0	4	3,200
Rybinsk Reservoir	7 (1953)	16	0	0	5,215	1,355	159	0	222	907	2,447	281	78	24,489	0	160	42,320
	10 (1956)	4	24	0	3,243	1,986	455	0	200.5	1,966	4,778	1,882	93.6	11,219	0	0	27,830
	11 (1957)	10	438	0	4,032	363	57	0	840	12,769	263	94.5	16	50	0	2.5	18,530
	12 (1958)	8	0	0	5,873	671	379	0	25	794	8,252	29	60	18,946	0	0	36,030
	15 (1961)	7	1.9	0	712	8.3	61.6	10	18	153	813	5,700	0	698	0	0	8,180
	16 (1962)	10	25.4	0	9,460	859	92.7	3.4	64.3	259.5	2,055	854	0	14,808	826	40	29,337
Uglich Reservoir	17 (1956)	13	2,570	62	19,873	1,661	0	0	276	51,871	892	11,260	2,062	11,019	2,428	221	101,610
	18 (1957)	4	0	0	13,658	78	73	0	30	22,872	18,645	223	2,045	10,349	336	147	68,460
	23 (1962)	20	114	1,668	4,790	24	158	74	46	182	31	353	32	19,400	2.5	0.2	25,100
Ivan'kovo Reservoir	20 (1956)	21	1,474	11	14,959	974	66	0	212	20,463	6,306	3,808	3,183	72,413	2,234	60	114,720
	21 (1957)	18	2,054	141	19,305	132	1,540	40	66	22,407	16,735	3,297	3,249	74,650	5,843	0	147,400
	26 (1962)	17	42.8	39	8,986	28.3	27.2	8.4	99	923	710	344	229	17,667	331	5.8	29,370
Sutka River	(1962)	19	8.1	0	1,132	16.3	14.3	0	38.2	61	923	161	2.5	1,305	0	57	3,720
Il'd River	(1962)	14	0.5	0	272	15	22	119	32	83	2,064	148	80	1,366	5.7	13	4,230
Shumarovka River	(1962)	18	2.6	0	250	18	21	13	48	31	1,642	25	84	1,329	28	28	3,520
Sunozhka River	(1962)	9	2.6	0	1,229	4.3	57	12	22	15	968	36	0	2,996	18	3.2	5,370
Ladka River	(1962)	10	0	0.001	220	2.2	85	9.3	45	19	2,922	28	188	2,176	2,695	3.5	8,400
Lake Poletskoe	(1964)	15	224	2	944	160	95	24	323	129	72	148	29	1,113	0	0	3,037
Lake 3 km SE of Orenburg	(1964)	1	0	0	418	2	422	0	36	24	88	90	0	10	0	0	1,090
Lake 7 km SE of Orenburg	(1964)	1	0	0	17	1	104	0	3	8	4	15	0	0	0	0	152
Pond near Pokrovka Village, Omsk Region	(1964)	1	0	28	86	0	224	0	0	0	0	0	0	0	0	0	310
Quarries in a swamp near Lake Poletskoe	(1964)	20	468	0	2,566	0	52	0.1	0.1	681	1,335	0	0	7	0	0	4,642

TABLE 14. Average biomass of Cladocera in different types of vegetation (late July—August 1962), in mg/combined m

Vegetation	Reservoir or river	No. of samples	Acroperus harpae	Biapertura affinis	Alona costata	A. guttata	Acroperus elongatus	Camptocercus rectirostris	Pseudochydorus globosus	Chydorus sphaericus	Eurycercus lamellatus	Graptoleberis testudinaria	Pleuroxus aduncus	P. truncatus	All Chydoridae	Sididae	Macrothricidae	Daphniidae	Polyphemus pediculus	Bosmina	All Cladocera
Submerged (Potamogeton, Elodea)	Ivan'kovo .	7	0.1	23.1	0.9	0	8	0.6	0	7	173	4	0	116	339	13,154	0	56	6	33	13,588
	Uglich . . .	3	0	0.3	0.03	0	19	0	0	135	0	2.7	0	2.8	161	3,555	0	51	4.5	26	3,958
	Sutka	4	4.4	0.2	0.2	0.2	0	0	1.8	0.6	620	0.02	1.3	5.5	640	973	0.4	62	7	0	1,683
	Il'd	1	1.6	7.2	0	0	0	0	0.5	5.6	435	0	0.02	4.8	455	29	0	99	0	0	583
	Shumarovka	6	0.3	0	0	0	0	0	0.4	0.4	96	0.03	0	0	103	0.5	0	97	1.3	0	202
	Sunozhka .	3	0.3	3	0	0	0	0.	0.3	0.9	557	0	0	29	591	1,622	0	774	7.3	0	2,995
Half-submerged, broadleaved (Sagittaria, Rumex, Sparganium)	Sutka	7	5.2	4.7	0.7	0.02	0	1.1	0.7	0.7	968	0	2	23	1,012	3	0	9	3	0	1,027
	Il'd	1	0	1.6	0	0	0	0	1.6	0.01	260	0	0.6	0.4	264	0	0	1.3	0	0	266
	Shumarovka	4	0	0	0	0	0	0	2	2.8	127	0	6	4.9	137	2	0	325	3	0	467
	Sunozhka .	4	0.03	7.1	0	0	0	0	1	2.3	18	0.02	0.2	13	51	143.5	11	197	0.2	0	403
	Ladka . . .	5	0.02	0	0	0	0	0	0	0.03	0	0.02	0	0	0.63	0	0	33.2	1	0	35
Half-submerged, linear-leaved (Phragmites, Glyceria, Scirpus, Carex, Equisetum)	Ivn'kovo . .	9	27	11	18	0	2	51	0.004	4.3	126	1.1	0	5.4	24	5,198	0	96	76	48	5,460
	Uglich . . .	16	0.7	2.7	0.6	0	29	1.7	0	21.5	43.6	0.02	0.05	1.1	86	248	0.1	59	141	1,080	1,622
	Rybinsk . . .	10	16	53	0.8	0.01	0	49	4	88	4,640	0.8	0	12	4,924	3,216	0.5	1,304	25	0	9,470
	Sutka	4	3.2	1	0.2	0	0	0	1.6	0.2	561	0	0.04	0	568	754	0.3	286	26	0	1,634
	Il'd	6	0.5	3.8	0.1	0.04	0	0	1.2	19	150	0.6	0.9	21.3	194	0	0.003	285	1.3	0	480
	Shumarovka	3	1.6	6.4	0	0	0	2.7	1.3	8.5	63	0	6.4	12	107	75	0	123	0.8	0	306
	Sunozhka .	1	0	8	0	0	0	0	0	0	0	0	0	0	8	4.3	8	184	0	0	205
Floating (Polygonum, Nymphaea, Nuphar, Potamogeton natans, Callitriche)	Ivan'kovo .	1	0	1	2	0	24	2.5	0	33	0	0	0	0	184	35	0	15	0	5.4	240
	Uglich . . .	1	24	60	0	0	48	0	0	3.6	52	0	0	8	196	36,554	0	1,520	180	1.2	38,451
	Sutka	4	6.1	1.5	0.01	0.01	0	0	0.4	0.5	70	0	0.6	14	97	64	1	70	1.4	0	234
	Il'd	6	0	5.4	0	0	0	0	0	0.3	6.8	0.7	0.3	0	14	2.2	0.1	4	0	0	21
	Shumarovka	5	1.4	5	0	0	0	0	0.2	0.8	32	0	0.2	8	59	0.02	0.008	44	4.8	0	108
	Sunozhka .	1	2.4	0	0.04	0.02	0	0	0	1	168	0	0	4.8	183	55	54	125	0.8	0	418
	Ladka . . .	4	0	0	0	0	0	0	0	0.2	0	0.4	0	0	2	0	0.4	128	2	0	133

TABLE 15. Average biomass of littoral fauna on bare bottom (late July – August) in mg/combined m

Reservoir or river	Age of reservoir and year of study	No. of samples	Biapertura affinis	Disparalona rostrata	Acroperus elongatus	Chydorus gibbus	Ch. sphaericus	Monospilus dispar	All Chydoridae	Sididae	Macrothricidae	Daphniidae	Polyphemidae
Volgograd . . .	3 (1961)	29	0	0.2	0	0	26	0	21.8	19	1	68	3.7
Gorki	6 (1961)	18	0.1	0.07	0	0.04	65.8	0.02	8.1	15	0.2	8.3	0
Rybinsk	19 (1960)	19	9.2	3.6	0.4	10.7	19.6	6.3	20	5	1.7	8	0.1
Uglich.	23 (1962)	17	0.4	1	1.9	0.3	84.1	0	89	29	0	365	0 6
Ivan'kovo . . .	26 (1962)	13	0.03	0.6	0	0.9	33.3	0	47	525	0	111	3.8
Sutka	(1962)	1	0.04	0	0	0	0.008	0	4.8	5.3	0.02	33.2	0.12
Il'd	(1962)	6	0.1	2	0	0	7.6	0	30	3.3	4	53	0.01
Shumorovka . .	(1962)	10	2.2	0.02	0	0.004	6.7	0	27	5	0	97	24
Sunozhka . . .	(1962)	8	3.1	0	0	0	9.4	0	67	71	0.4	58	4
Ladka	(1962)	10	0	0	0	0	0.1	0	24	0	0	9	3.2

TABLE 15 (continued)

Reservoir or river	Age of reservoir and year of study	No. of samples	Bosmina	All Cladocera	Ostracoda	Cyclopoida	Calanoida	Hydracarina	Chironomidae	Other Insecta	Oligochaeta	Gastropoda	Hydridae	Weight of fauna (except Rotatoria and Protozoa)
Volgograd	3 (1961)	29	15.5	290	0	163	110	0	26.8	42.9	7.9	0	1.2	802
Gorki	6 (1961)	18	0.7	35	1	93.6	36	18.5	11.8	0	6.6	7.5	0	210
Rybinsk.	19 (1960)	19	2	79	1.1	39	7	1.2	10	0	14	0	0	152
Uglich	23 (1962)	17	10.6	680	0.5	33.3	26.1	2	3.1	0.2	120	44.0	0.1	911
Ivan'kovo	26 (1962)	13	32	751	0.07	11.1	4.3	0	59	16	67	0	538	1,447
Sutka	(1962)	1	0	43.5	0.16	1.3	0	0	0.5	24	0	120	0.3	190
Il'd	(1962)	6	0.004	90.4	12.3	7.7	16	0.6	3.6	18	0	12.4	0.1	161
Shumorovka	(1962)	10	0.008	153	1.1	32	15	4	0.17	5.5	10	12	0.12	205
Sunozhka	(1962)	8	0.001	200.5	1.7	79	12	0.5	10	0.05	21	542	0.9	868
Ladka	(1962)	10	0	36.2	0.4	4.6	0	0.02	4.2	32	3.2	148	6.6	237

TABLE 16. Average biomass of Cladocera on different types of bottom in the bare littoral (late July—August 1962), mg/combined m

Bottom	Reservoir or river	No. of samples	*Biapertura affinis*	*Disparalona rostrata*	*Acroperus elongatus*	*Chydorus gibbus*	*Ch. sphaericus*	*Leydigia leydigi*	All Chydoridae	Sididae	Macrothricidae	Daphniidae	*Polyphemus pediculus*	*Bosmina*	All Cladocera
Sand	Ivan'kovo	10	0.04	1.6	0	1.15	25	0	30	24	0	22	0.14	10	120
	Uglich	9	0.6	1.4	1.8	0.5	57	0	64	17.5	0	285	1	7.3	294
Silt	Ivan'kovo	2	0	1	0	0	1.6	0	45	3,285	0	17	24	129	3,500
	Uglich	2	0	0.05	0	0.1	59	0	60	16	0	757	0.3	22	899
	Sutka	1	0.04	0	0	0	0.01	0	4.8	5.3	0.02	33.2	0.12	0	44
	Il'd	6	0.1	2	0	0	7.6	0.3	30	3.3	4	53	0.01	0.004	91
	Shumarovka	10	2.2	0.02	0	0.004	6.7	0.02	27	5	0	97	24	0.01	153
	Sunozhka	8	3.1	0	0	0	9.4	0	67	71	0.4	58	4	0.001	200
	Ladka	10	0	0	0	0	0.1	23	24	0	0	9	3.2	0	36
Stones	Ivan'kovo	1	0	2	0	0	184	0	186	10	0	720	0	57	1,053
Clay	Uglich	6	0.3	0.7	2.7	0.03	133	50	183	50	0	354	0	12	860

about the affinity of Chydoridae for particular species of plants. The average biomass of Chydoridae (per combined meter) is proportional to the area covered by the coastal vegetation of the reservoir (Figure 176). In the Volga reservoirs, the area covered by macrophytes is largest in the Ivan'kovo Reservoir and smaller in the other reservoirs downstream.

The fauna has a very low biomass in the open littoral despite the presence of species characteristic for it such as *Chydorus gibbus*, *Pleuroxus uncinatus*, *Monospilus dispar*, and *Disparalona rostrata*. *Biapertura affinis* and *Chydorus sphaericus* are the most abundant species in the open littoral of all upper Volga reservoirs and rivers. No relationship was found between the abundance of Chydoridae and particular types of bottom (Table 16). The distribution of Chydoridae 135 on sand is irregular, i. e., the depressions on the sand ripples contain at least $^3/_4$ of the Chydoridae per m^2 together with silt particles (data of 15 September 1965, Rybinsk Reservoir).

In years with a high water level and abundant coastal vegetation, Chydoridae attain an average biomass of about 5 g per combined meter ($1\ m^3 + 1\ m^2$ of bottom) in the Rybinsk Reservoir (Smirnov, 1963b). The biomass of Chydoridae increases slowly between spring and mid-July, and then sharply to a peak until August—September. Males appear in some species in late August. The biomass of Chydoridae decreases slightly in October. The coastal vegetation hardly develops in years with a low water level. The biomass of Chydoridae increases slowly until late August but reaches an average of only about 1 g per combined meter. *Eurycercus lamellatus* is practically absent in such years. This was observed throughout the littoral of the Rybinsk Reservoir in June and August 1960, when the water level was low. Our expeditions in the littoral of the Rybinsk Reservoir in the very dry year of 1960, when coastal vegetation was completely absent, showed that the average biomass of Chydoridae in June was about 2 mg/combined meter, but it increased in August to 20 mg/combined meter. Thus, the late summer increase in the biomass of Chydoridae observed by Mordukhai-Boltovskoi, Mordukhai-Boltovskaya, and Yanovskaya (1958) took place in the absence of vegetation in a very dry year, but the increase was small. In the Rybinsk Reservoir, species such as *Acro-* 138 *perus harpae*, *Camptocercus rectirostris*, *Eurycercus lamellatus*, *Graptoleberis testudinaria*, and *Pleuroxus truncatus* develop in masses if there is vegetation but are practically absent in dry years. No relationship was found between the biomass of Chydoridae and the species of the vegetation (Table 14). However, the degree of protection provided by the littoral (i. e., thickness of vegetation) has an influence, and different Chydoridae predominate in the littoral according to the 139 density of vegetation (Rybak, Rybak, and Tarwid, 1964).

No relationship was found between the biomass of Chydoridae and the age of the reservoir. As shown in Tables 13 and 15, the biomass fluctuates irregularly. We examined the condition of the littoral fauna of the Cherepovets Reservoir in the first year of its existence in August, September, and October 1963. Aquatic vegetation was almost absent in that year, but flooded meadow or forest vegetation was found at all stations. In the first year of the existence of the Cherepovets Reservoir, the littoral fauna showed a mass development of Cladocera, especially Daphniidae. There were numerous

species, and 36 species of littoral Cladocera were found (Table 17). However, there were few Chydoridae, and Daphnia pulex was the most common form (Smirnov, 1966d). A severe deficiency of oxygen affected large areas of the Cherepovets Reservoir in its first year. Data on intensive bacterial decomposition and oxygen deficiency were published by Margolina (1965). The minimum O_2(mg/liter) for Daphnia pulex, Simocephalus vetulus, and S. exspinosus is 0.4; for Daphnia hyalina, which was very scarce in the littoral of the Cherepovets Reservoir, the minimum is 1.3 (at 22° C) (Herbert, 1954). Ceriodaphnia rotunda, which is more resistant to an oxygen deficiency (Macan, 1963), was abundant in August. The minimum O_2 for Eurycercus lamellatus, Acroperus harpae, Biapertura affinis, Camptocercus rectirostris, and Chydorus sphaericus varies from 1.3 to 1.9 (at 20° C; Bogatova, 1962). These values explain the small part of Chydoridae in the fauna of Cladocera. On the other hand Eurycercus lamellatus was a very important component of the food of fish in the Gorki Reservoir in its first year. In the first year after the flooding of the Kuibyshev Reservoir
140 there was a mass multiplication of E. lamellatus, which also grew to extraordinary lengths (to 5 mm) at the time (Chernysheva, 1966). The biomass of Chydoridae fluctuated markedly in the following years. In the bare littoral, there is no definite relationship between the age of the reservoir and the biomass and species composition of Chydoridae (Table 15).

(139)

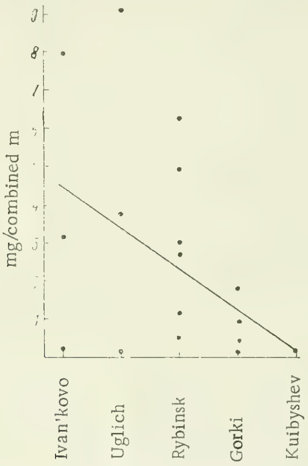


FIGURE 176. Average biomass of phytophilic Chydoridae during peak development (August) in the Volga reservoirs (data from 1953–1962)

Data on the relative abundance of different species are given in Tables 18, 19, 26, and 27.

According to Frey (1958), the resistance of Chydoridae to environmental factors can be evaluated from the distribution of their remains in sediments. Thus, Eurycercus lamellatus, Acroperus harpae, Chydorus sphaericus, and Biapertura affinis are eurybiotic, but Alonella nana is apparently stenobiotic.

138) TABLE 17. Cladocera in the littoral of rivers in the Volga pool of the Rybinsk Reservoir and in the Cherepovets Reservoir

Species	Sutka	Il'd	Shumarovka	Sunozhka	Ladka	Cherepovets		
						1963	1964	1966
Acroperus harpae	+	+	+	+	+	+	+	+
Biapertura affinis	+	+	+	+	-	+	-	+
Alona costata	+	+	-	+	-	+	-	+
A. guttata	+	+	+	+	-	-	-	-
A. quadrangularis	+	+	-	-	+	-	+	-
A. rectangula	+	+	+	+	+	+	-	-
Alonella excisa	-	-	-	-	-	+	-	-
A. exigua	-	+	+	+	-	+	-	-
Disparalona rostrata	-	+	+	-	-	-	+	-
Camptocercus lilljeborgi	+	+	-	-	-	+	+	+
C. rectirostris	+	+	+	+	-	+	+	+
Chydorus gibbus	-	-	+	-	-	-	-	-
Pseudochydorus globosus	+	+	+	+	-	+	+	+
Chydorus sphaericus	+	+	+	+	+	+	+	+
Eurycercus lamellatus	+	+	+	+	+	+	+	+
Graptoleberis testudinaria	+	+	+	+	+	+	+	+
Leydigia leydigi	-	+	+	-	+	-	-	-
Monospilus dispar	-	-	-	-	-	+	-	-
Oxyurella tenuicaudis	-	-	+	-	-	-	-	-
Pleuroxus aduncus	+	+	+	+	-	+	-	-
P. laevis	+	+	+	-	+	+	+	-
P. striatus	-	+	+	+	-	+	+	-
P. trigonellus	-	-	-	-	-	+	+	+
P. truncatus	+	+	+	+	-	+	+	+
P. uncinatus	-	+	+	-	+	-	+	-
Lathonura rectirostris (O.F.Müller)	+	-	-	+	+	+	-	-
Macrothrix laticornis (Jurine)	+	+	+	-	-	+	-	-
Diaphanosoma brachyurum Liévin	+	+	+	+	-	+	+	+
Limnosida frontosa Sars	-	-	-	-	-	+	-	-
Sida crystallina (O.F.Müller)	+	+	+	+	-	+	+	+
Ceriodaphnia laticaudata P.E.Müller	-	-	-	-	-	+	-	-
C. pulchella Sars	+	+	+	+	+	+	+	+
C. quadrangula (O.F.Müller)	+	+	+	+	+	+	+	-
C. reticulata (Jurine)	-	-	-	-	-	+	-	+
C. rotunda Sars	-	-	-	-	-	+	-	-
Daphnia longispina O.F.Müller	-	-	+	+	+	+	+	-
D. pulex (De Geer)	-	-	-	-	-	+	-	-
Scapholeberis aurita (S.Fischer)	-	-	+	-	-	-	-	-
S. mucronata (O.F.Müller)	+	+	+	+	+	+	-	+
Simocephalus exspinosus Koch	-	-	-	-	-	+	+	-
S. vetulus (O.F.Müller)	+	+	+	+	+	+	+	-
Polyphemus pediculus (Linne)	+	+	+	+	+	+	+	+
Bosmina coregonis Baird	-	+	+	+	-	+	+	-
B. longirostris (O.F.Müller)	-	-	-	-	-	+	+	-
Total species of Cladocera in the littoral zone	24	29	30	24	16	36	24	17

(139) TABLE 18. Density of Chydoridae in the vegetation of the Rybinsk Reservoir near Borok, high water level, organisms/combined m

Species	24 July 1961 Polygonum	10 August 1961 Polygonum	23 August 1961 Polygonum	29 August 1961 Polygonum	12 July 1962 Mannagrass	1 August 1962 Sedge	15 August 1962 Sedge
Chydorus sphaericus	2,560	4,480	56,320	21,200	5,280	4,680	16,210
Ch. gibbus	0	0	0	79	324	400	164
Eurycercus lamellatus	0	0	3,200	470	4,400	4,530	12,280
Pleuroxus truncatus truncatus	1,280	4,480	6,720	9,536	880	360	168
P. laevis	1,280	0	0	0	240	0	168
P. aduncus	0	0	16	64	1,000	0	0
P. striatus	32	640	960	0	800	404	80
P. trigonellus	0	0	0	0	80	0	0
Graptoleberis testudinaria	7,680	16	960	3,264	80	80	0
Alonella excisa	0	0	0	0	3,400	560	560
Camptocercus rectirostris	1,280	32	960	1,411	320	480	404
C. lilljeborgi	0	0	0	0	0	4	160
Acroperus harpae	32	320	320	832	480	320	576
Biapertura affinis	0	32	0	137	660	600	810
Alona costata	0	0	0	0	80	244	84
A. guttata	0	0	0	0	90	0	4
A. rectangula	0	0	0	0	84	0	0

140 TABLE 19. Density of Chydoridae in the open littoral of the Rybinsk Reservoir, 1961, low water level, organisms/combined m

Species	5 July, Borok	16 July, Borok	26 July, Borok	16 August, Vereteya	12 August, Yana	12 August, Srednyi Dvor	14 August, Kargach	16 August Bol'shie Zalomy	10 August, Bezymyannaya stantsiya
Chydorus sphaericus	1,080	1,080	1,240	280	3,320	492	400	400	2,000
Ch. gibbus	80	80	160	480	0	0	9,400	3,020	160
Pleuroxus uncinatus	0	0	1,000	0	0	0	0	0	320
Disparalona rostrata	0	0	0	240	180	4	1,000	70	400
Camptocercus rectirostris	0	4	1,000	0	0	0	0	0	0
Acroperus harpae	8	0	0	0	0	0	0	0	0
A. elongatus	1,960	80	0	80	4	4	0	0	0
Biapertura affinis	0	0	0	0	0	0	0	4,000	12
Monospilus dispar	2,000	80	80	0	4	20	7,000	0	960
Rhynchotalona falcata	0	0	0	0	4	0	4	0	0

EFFECT OF ENVIRONMENTAL FACTORS ON CHYDORIDAE

Chemical Factors

In the discussion of the action of the legs, we concluded that Rhynchotalona falcata and Monospilus dispar are associated with the bare littoral because the exopodites of the legs do not pump water or take part in the gas exchange. Oxygen is relatively abundant in the open littoral. In other specific inhabitants of the open littoral, viz., Chydorus gibbus, Pleuroxus uncinatus, and Acroperus elongatus, the exopodites vibrate and the relationship with this particular environment may be found in their morphology and physiology (e. g., the absence of hemoglobin). There are some data available on the oxygen uptake of Chydoridae (Table 6). Table 20 shows the response of some Chydoridae to an oxygen deficiency.

TABLE 20. Lethal concentration of oxygen

Species	O_2, mg/liter	t, °C	Reference
Eurycercus lamellatus	1.7	19–21	Bogatova, 1962
Eurycercus lamellatus	0.44	16	Pacaud, 1939
Pleuroxus truncatus	1.1	19–21	Bogatova, 1962
Chydorus sphaericus	0.66	22	Pacaud, 1939
Chydorus sphaericus	0.37	19–21	Bogatova, 1962
Chydorus sphaericus	0.30	16	Pacaud, 1939
Biapertura affinis	1	19–21	Bogatova, 1962
Acroperus harpae	1	19–21	Bogatova, 1962
Camptocercus rectirostris	1.4	19–21	Bogatova, 1962

141 In the Cherepovets Reservoir, Chydoridae were scarce during the severe frost which occurred in the first year after flooding; at the same time there were large numbers of Daphniidae. Survival in an oxygen-free environment depends on the presence of certain substances in the water and on the characteristics of the species. Thus, movement ceases after the following periods in a solution saturated with CO_2: Chydorus sphaericus after 1 minute, and Alona quadrangularis after 1 minute 40 seconds (Mudretsova-Viss, 1933). The corresponding values for a solution saturated with hydrogen are: Chydorus sphaericus after 18 hours, and Alona quadrangularis after 4 hours (Mudretsova-Viss, 1933).

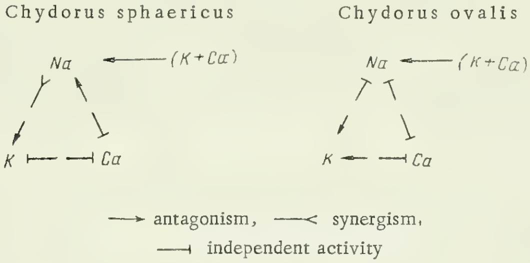
The data on the lethal concentrations of chemicals for Chydoridae are of interest because they explain their response to concentrated solutions, industrial and human waste, and the effect of very active substances introduced into the water. To determine the lethal concentration, each of the solutions examined was distributed in three vessels each with 10 crustaceans. The solutions were made up with water brought from the Rybinsk Reservoir. Of particular interest (Table 21) is the death of Chydoridae in dilute solutions of silver nitrate, when reduced silver precipitated on the gills and interfered
142 with the respiration. Solutions of chromium compounds are highly toxic for Chydorus sphaericus. Potassium permanganate and formalin are lethal in slightly higher concentrations. The following comparison with

(141) TABLE 21. Concentrations which kill 100% of Chydorus sphaericus in 24 hours (percent)

Solution	Survival	Death	t, °C	pH
Potassium hydrogen sulfate . . .	0.01	0.05	21.2 – 20.2	6.8
Potassium carbonate	0.01	0.05	19.8 – 19.1	7.6
Potassium nitrate	0.05	0.1	19 – 17.4	7.0
Potassium bromide	0.05	0.1	17.4 – 17.6	7.4
Potassium bichromate	0.0001	0.0005	22.2 – 22.4	7.2
Potassium citrate, disubstituted	0.05	0.1	17.6 – 18.3	7.4
Potassium ferrocyanide	0.05	0.1	19.5 – 19.4	–
Potassium permanganate	–	0.003	21 – 21.4	–
Potassium acetate	0.05	0.1	18.6 – 19	7.2
Potassium phosphate, monosubstituted	0.05	0.1	21.4 – 21.6	7.2
Potassium phthalate	0.1	0.3	19.4 – 20.2	7.2
Potassium ferricyanide	0.01	0.05	20.2 – 19.4	–
Potassium bromate	0.01	0.05	19.4 – 19.2	7.4
Potassium hydroxide	0.02	0.05	21.2 – 21.6	7.4
Potassium iodide	0.05	0.1	18.4 – 18.6	7.4
Potassium bicarbonate	0.05	0.1	19.7 – 19	8
Potassium chloride	0.05	0.1	17.3 – 17.8	7.0
Sodium silicate	0.25	0.5	18.7 – 18.6	–
Sodium tetraborate.	0.5	1	18.6 – 19.8	–
Sodium phosphate, monosubstituted	0.5	1	19.8 – 19.7	–
Sodium hyposulfite	0.5	1	23.2 – 22	7.4
Sodium bromide	0.05	0.5	22 – 20	7.6
Sodium iodide	0.05	0.5	22.1 – 22	7.6
Sodium nitroprussiate	0.05	0.5	20.2 – 20.2	7.4
Sodium nitrate	0.1	0.5	12.2 – 12	7.2
Sodium sulfate	0.5	1	18.2 – 18.4	–
Sodium acetate	1	2	18.2 – 18.3	–
Sodium citrate, trisubstituted	0.05	0.5	18.2 – 18.9	–
Sodium sulfosalicylate	0.1	0.5	18.9 – 19	–
Sodium bicarbonate	0.25	0.5	18.9 – 19	8.4
Sodium chloride	0.25	0.5	18.6 – 18.7	7.6
Sodium formate	0.5	1	18.6 – 18.7	7.6
Magnesium nitrate	0.1	0.5	16.2 – 16.3	–
Barium nitrate	0.005	0.01	16.1 – 16.3	–
Silver nitrate (precipitate on the gills). . .	0.0000003	0.00001	19.4 – 19.4	7.2
Magnesium sulfate	0.1	0.5	19.0 – 19.2	7.4
Chromic anhydride.	0.0001	0.001	20	7.6
Zinc sulfate	0.005	0.05	11.4 – 12	7.2
Zinc acetate	0.005	0.05	12	7.6
Methanol	6.5	7	18.4 – 18.6	7.1
Ethanol	5	5.5	18 – 18.2	6.0
Formalin, neutralized	0.001	0.004	18 – 18.4	7.0

Daphniidae is instructive. Scapholeberis kingi Sars dies in 0.004% neutralized formalin, Simocephalus vetulus in 0.0006% of the same compound (it lives more than 24 hours in 0.0005% formalin); the lethal concentrations of ethyl alcohol are 3% for Scapholeberis kingi (which survives at 2.5%) and 2.5% for Simocephalus vetulus (survives at 2%). Daphnia magna Straus dies in 24 hours in 0.002% formalin (Nazarenko, 1960). Both sexes of Disparalona rostrata die in 6 minutes in 0.1% formalin. According to field data published by Myaemets (1961b) the following species live in concentrations of Ca^{2+} of from 7 to 70 mg/liter: Eurycercus lamellatus, Acroperus harpae, Biapertura affinis, Alona guttata, A. costata, A. rectangula, Leydigia leydigi, Graptoleberis testudinaria, Chydorus sphaericus, Monospilus dispar; Biapertura intermedia and Chydorus ovalis live in soft water (about 5–15), Pleuroxus laevis and P. aduncus in hard water (about 31–50). Chydorus sphaericus and Eurycercus lamellatus tolerate concentrations of Mg^{2+} of up to 100 mg/liter in nature (Røen, 1962). Chydorus sphaericus shows a similar resistance to these ions in experimental conditions.

Triple distilled water is toxic for Chydorus ovalis (Vinberg, 1933). Combinations of ions act as follows (Vinberg, 1933):



The lethal concentration of potassium thus decreases in the presence of sodium but is not affected by calcium. These reactions vary in the different species. Røen (1962) determined the electrical conductivity at which different Chydoridae live in nature. It was found that Eurycercus glacialis and Chydorus sphaericus tolerate a wide range of electrical conductivity (20–2,000 μmho); the range for Alona quadrangularis is 20 to 170 μmho. Ethanol in a concentration of 0.125% stimulates the reproduction of Chydorus ovalis, but a concentration of 1% rapidly kills this species (Yatsenko, 1928b).

According to field data, the following species are highly euryionic and tolerate pH values from 4 to 9: Acroperus harpae, A. elongatus, Alonella nana, Chydorus ovalis, and Ch. sphaericus (Myaemets, 1961b; Røen, 1962). Camptocercus lilljeborgi, Oxyurella tenuicaudis, Pleuroxus uncinatus, Chydorus latus, and Ch. gibbus live in an alkaline environment (pH 7–9) (Myaemets, 1961b). According to Yatsenko (1928a), Ch. sphaericus reproduces at a pH of 5–9, 143 and its growth rate at extreme pH values is greater than at a neutral pH. In a study of the growth rate of cultures of Ch. sphaericus at 6, 13, and 23° C and at different pH values for each temperature, Yatsenko obtained the greatest increase at 23° C and a pH of 5. Ch. ovalis reproduced at a pH of 5—9; the growth rate of its cultures at extreme pH values is greater than at a neutral reaction (Yatsenko, 1928a). Yatsenko also determined the oxygen uptake of Ch. ovalis at 6, 13, and 23° C and at different pH values. At a pH of 5 and 9 and at all the temperatures mentioned, Ch. ovalis consumes much more oxygen than at a neutral reaction or at extreme pH values. The optimum pH for the reproduction of Eurycercus lamellatus is about 5.6 (Table 22; Salazkin et al., 1968). The upper lethal value of pH for Acroperus harpae, Chydorus sphaericus, and Pleuroxus truncatus is 10.6; Eurycercus lamellatus survived at a pH of 11 under the same conditions (Bogatova, 1962). According to Yatsenko (1928a), Chydorus sphaericus cannot live for more than 24 hours at a pH of 2.75, but a few individuals survive at a pH of 3.0; adults can live at a pH of 3.5, which is tolerated by the young of the first stage for at most 24 hours, and the whole culture dies in 4 days under these conditions. A pH of 4.5 is the minimum value for reproduction; under these conditions, however, the population grows only little and males appear. At a pH of 10.0, the young of the first stage live at most for 24 hours. Alonella excisa can be cultured at an alkaline reaction, but it also survives in acid water (Yatsenko, 1928a). According to our experiments, the range of pH for Eurycercus lamellatus is 3.8—11; it dies in 4 hours at a pH of 2.8 and 12. The optimum salinity for Chydorus sphaericus is 0.010—0.320 (in grams of Cl^-/liter)(Ulomskii, 1955a). The maximum salinity tolerated by some Chydoridae is shown in Table 23.

(142) TABLE 22. Reproduction of Eurycercus lamellatus at different pH values obtained by extract of sphagnum peat (after Salazkin et al., 1968)

	3.5—3.8	4.6—5.0	5.6—6.0	6.8—7.2
Development until the first batch of progeny, days	15	12—13	13—14	18
Development of embryos, days	5	2—4	3—4	4
Litters (from - to)	1—3	1—7	3—10	2—5
Average number of young per batch. .	3	8	13	4
Total number of young	6	24	65	8

The introduction of polychlorpinene at a concentration of 0.25 mg/liter into the water kills Alonella excisa (Mantel'man, 1960). Chydorus sphaericus concentrate on and inside the shells of larger dead Cladocera. The optimum range of oxidation for Ch. sphaericus is 5.2—12.8 mg O_2/liter (Ulomskii, 1955a, 1955b). Ch. sphaericus enriches the water with phosphates, which it liberates from organic phosphorus compounds (glycerophosphate) at a rate of 0.0154 γ phosphate phosphorus per organism per hour (at 13—20° C; Margalef, 1951).

TABLE 23. Upper limit of salinity for Chydoridae, ‰

Species	Maximum salinity	Reference
Acroperus harpae	3	Bening, 1941
Biapertura affinis	5	Myaemets, 1961b
Alona pulchella	2.3	Löffler, 1961a
A. rectangula (Aral Sea) ...	13.8	Bening, 1941
Eurycercus lamellatus ...	3.06	Bening, 1941
Leydigia acanthocercoides	2.1	Löffler, 1961a
Oxyurella tenuicaudis ...	6	Löffler, 1961a
Pleuroxus trigonellus	2.1	Löffler, 1961a

Physical factors

Chydoridae hatch from resistant eggs in late April at a low temperature and attain maximum density by the late summer, when the water is thoroughly warmed. However, the warming of water precedes the increase in the biomass of Chydoridae, which is apparently associated with the growth of vegetation. Myaemets (1961b) published data on the range of temperatures at which he found Chydoridae. Acroperus harpae, A. elongatus, Biapertura affinis, Graptoleberis testudinaria, Pleuroxus trigonellus, Alonella nana, and Chydorus sphaericus occur in a wide range of temperatures (3—27°); Anchistropus emarginatus was found at 17—23° C. We found Alona quadrangularis, Camptocercus rectirostris, Chydorus gibbus, Monospilus dispar, and Pleuroxus uncinatus at temperatures up to 31° C. However, Chydorus sphaericus lives under the ice, as do Alona guttata (Bening, 1941), A. rectangula (Bening, 1941; Ulomskii, 1955a, 1955b; Larsen, 1959), Alonella exigua (Filimonova, 1956), Leydigia leydigi (Voronina, 1959), and Alona quadrangularis and Graptoleberis testudinaria (after Kosova). According to Konstantinova (1957, 1961), Chydorus sphaericus lives at 3—30° C and reproduces at 5—28° C; the optimum temperature for reproduction is 25° C. It has been recorded that Ch. sphaericus survives even after having been frozen in ice (Zernov, 1928; Boldyreva, 1930; Kapterev, 1938). In view of these re-
144 ports we examined the effect of near-zero temperatures and freezing on Ch. sphaericus. Cooling and freezing were carried out in distilled water, with ten female Ch. sphaericus of length 0.4 mm. The specimens were taken from a culture kept at 15—17° C and were isolated in test tubes. It was established that Ch. sphaericus survives for several days in distilled water. We first transferred several specimens of Ch. sphaericus from the culture at 15° C to water at 0°C (with melting snow). Movements were as active as in the culture for the first 15—20 minutes. The animals did not settle on the substrate and did not avoid the melting snow. The specimens were then put into test tubes placed into melting snow. Their movements became less active in half an hour, and they became immobile after 3 hours. The animals tolerated a 5-hour exposure to a near-zero temperature and began to swim normally when the temperature

rose. A further experiment in which Ch. sphaericus was kept for 22 hours at a temperature of from -1 to +0.5°C ended in the death of 3 of the 10 specimens. Supercooling of the water to temperatures of -1.5 to -9.2°C (without freezing) killed all specimens. Freezing for 17 hours (three experiments at temperatures from -4 to -5°C, -3 to -8°C, and -3.5 to -8.5°C) and brief thawing (immediately after the animal was frozen in the ice, two experiments) killed the animals. All crustaceans died after brief freezing in water taken from the reservoir. We attempted the immediate thawing of frozen crustaceans at temperatures of 3.3 to 5.5°C. In this case also they all died. Thus, a water temperature of about 0° is the lethal limit for Ch. sphaericus. However, resistant eggs apparently tolerate freezing in ice under natural conditions.

The data on the upper lethal temperatures for Chydoridae are given in Table 24.

TABLE 24. Upper lethal limit of temperature

Species	t, °C	Reference
Acroperus harpae	32–37	Bogatova, 1962
Biapertura affinis	33–38	Bogatova, 1962
Camptocercus rectirostris	36	Bogatova, 1962
Pseudochydorus globosus .	33	Bogatova, 1962
Chydorus sphaericus	36	Bogatova, 1962
Ch. sphaericus	33	Mortimer, 1936
Eurycercus lamellatus ...	32	15 minutes (our data)
Pleuroxus truncatus	33	Bogatova, 1962

Alonella excisa is best cultured at 22°C and a pH of 9.5, and Chydorus sphaericus at 23°C and pH 5.0 (Yatsenko, 1928a). Oxyurella tenuicaudis attains maturity at 23°C in 5 days, and much later at 17°; it produces young every 48 hours at 21–25°C and every 6 days at 19°C (Chorik, 1964).

Chydorus sphaericus attained maturity in 3 days in containers placed in the Gorki Reservoir at 23° C; it became mature at 18° C after 4–5 days, and embryonic development lasted 2 and 4 days respectively at the above temperatures (Petrova, 1967).

Cooling to 3°C for 4 hours caused no visible effect in Acroperus harpae, Chydorus sphaericus, Eurycercus lamellatus, Pleuroxus aduncus, P. striatus, and P. truncatus. Eurycercus lamellatus (length 2 mm) remained mobile in melting snow; females survived, molted, and produced a viable young under these conditions.

Chydoridae have a very irregular vertical distribution. The numbers of Alonella excisa and Biapertura affinis collected on the bottom are several times greater than those obtained on the surface; conversely, Pleuroxus truncatus occurs mainly at the surface (Korde, et al., 1926). Chydorus sphaericus remains close to the bottom during the day but shows a uniform vertical distribution after sunset (Berg and Nygaard, 1929). Diurnal movements have been found in Eurycercus lamellatus, Acroperus harpae, and Alona quadrangularis; these species live on plants near the bottom during the day, but some of them rise to the surface at night (Szlauer, 1963). According to Zimbalevskaya (1966b), the distribution of Camptocercus rectirostris and Oxyurella tenuicaudis on plants depends mainly on depth, and their density increases with depth.

145 Chydoridae are scarce in the profundal. No living Chydoridae were found at a depth of 18 m in the Rybinsk Reservoir, apparently because of the lack of oxygen at such a depth. The maximum depths at which Chydoridae were found are given in Table 25. The species listed in the table therefore also tolerate the pressures at these depths (if the specimens were in fact alive).

TABLE 25. Maximum depth at which Chydoridae were found, m

Species	Depth	Reference
Eurycercus lamellatus ...	150	Zschokke, 1911
Pleuroxus aduncus	35	Monard, 1919
P. trigonellus	85	Monard, 1919
P. truncatus	45	Monard, 1919
P. uncinatus	65	Monard, 1919
Disparalona rostrata.....	114	Monard, 1919
Chydorus sphaericus.....	144	Monard, 1919
Pseudochydorus globosus .	23	Monard, 1919
Chydorus piger	88	Monard, 1919
Anchistropus emarginatus	12	Monard, 1919
Alona quadrangularis	105	Monard, 1919
A. costata	114	Monard, 1919
A. rectangula	28	Monard, 1919
Acroperus angustatus	28	Monard, 1919
Alona setosocaudata	133	Vasil'eva and Smirnov, 1969
Camptocercus rectirostris	150	Zschokke, 1911
Biapertura affinis	120	Zschokke, 1911
Monospilus dispar	84	Monard, 1919
Leydigia leydigi	84	Monard, 1919

Mixing of water by waves and stirring of sediments are common features of the environment of Chydoridae. However, Manuilova (1956) found a sharp increase in the percentage of dead crustaceans caused by strong waves and stirring of sediments; the ratio between live and dead Chydorus sphaericus was 2.9:1 after a storm. Manuilova attributes the adverse effect of strong waves to the fact that they stir the bottom sediments. A distinction should be made between the effect of strong mixing of water and the effect of suspensions in the water. In order to determine the effects of waves, suspensions, and other factors, and the possible protective function of vegetation against wave action, we examined the survival of Chydoridae in containers with water which were shaken.

The crustaceans were placed in flasks with 60 ml of water. The flasks were shaken 200 times per minute in a shaking machine. Eurycercus lamellatus (length 0.9 mm) showed a mortality of 50% after 7 hours and 100% after 9 hours. All specimens survived in the control flasks, which were not moved. The addition of sand (average size of sand grains 0.2 mm) at the rate of 5 g/liter did not accelerate the death of E. lamellatus. For comparison, we made a similar experiment with Daphnia pulex. Shaking 200 times per minute killed 50% of D. pulex in 6 hours. These findings show that prolonged exposure to strong waves may cause a high mortality in the Chydoridae.

The photoperiod influences the beginning of gamogenesis in Pleuroxus denticulatus. Specimens from Florida became gamogenetic at a long photoperiod, while specimens from Minnesota became so at a short photoperiod (Shan and Frey, 1968).

Light determines the direction of swimming of Chydoridae. When kept in the dark, Chydorus sphaericus lives long and produces a numerous progeny (Table 11). There is no sharp difference in cultures kept in the light, but they do show a slight decrease in the length of life and the number of young. Strong illumination with incandescent light (about 50,000 lux) rapidly kills part of the population of Eurycercus lamellatus, which indicates that the intensity of light used is near the maximum value. Bryukhatova (1928) found that Chydorus sphaericus and Ch. ovalis are distributed uniformly in the container after prolonged shading; in Ch. sphaericus, the negative phototaxis becomes positive when the CO_2 content increases. Addition of sulfuric acid to a pH of 6.82 replaces the negative phototaxis of Ch. sphaericus with a uniform distribution in the vessel, but the crustaceans show a positive phototaxis at a pH of 6.22
146 (Bryukhatova, 1928). If CO_2 makes the water acid, positive phototaxis appears at higher pH values — up to 7.89. In the water of the Rybinsk Reservoir the crustaceans concentrated on the illuminated side of the container at a pH of 6.8—7.0. Anchistropus emarginatus concentrated on the illuminated side (Borg, 1935a, 1935b, 1936); this reaction is also characteristic for the Hydra on which this species lives.

It was found in connection with engineering that an electric current of 400 V/cm is lethal for Chydorus sphaericus at 15—20°C if the longitudinal axis of the body is perpendicular to the direction of the current, and less if this axis is parallel to the direction of the current or at a lower temperature (Kirpichenko, Mikheev, and Shtern, 1963). All these data refer to females; nothing is known on the tolerance of males.

Biotic Factors

A discussion of the relationship between Chydoridae and other organisms has to stress their abundance in the vegetation. However, most Chydoridae are only indirectly connected with plants, which they use either as a substrate or which create a suitable environment. Many Chydoridae (Acroperus harpae, Pleuroxus, Chydorus) are also abundant in filamentous algae (Hydrodictyon reticulatum Lagerh.). Some Chydoridae were found in the water in tree hollows (Biapertura affinis, Chydorus). Mass development of Chydorus sphaericus in open water coincides with mass development of blue-green algae (Birge, 1879:342; Apstein, 1896:95–96; Scourfield, 1898:4–5; Wesenberg-Lund, 1904:178; Woltereck, 1913; Berg and Nygaard, 1929:250).

Numerous data prove the importance of Chydoridae as food for fish, which apparently actively pursue them. Thus, Eurycercus lamellatus forms 9% of the food for perch but only 3% of the littoral fauna in the Lipno Reservoir (Straškraba, 1965b). Chydoridae are eaten by invertebrates and predatory plants. Young Eurycercus lamellatus are attacked by nymphs of the mite Hydrochoreutes krameri (determined by Vainshtein); they attach themselves dorsally and suck blood from the heart region (Rybinsk Reservoir, Borok, July 1965). Predatory oligochetes of the family Naididae are important predators of Chydoridae. In the Volga reservoirs, Chaetogaster diaphanus Gruith. preys on Alonella excisa, Chydorus sphaericus, Pleuroxus truncatus, Graptoleberis testudinaria, Camptocercus rectirostris (to 0.7 mm long), and Eurycercus lamellatus (young to 0.7 mm long). Chaetogaster diaphanus also attacks Alonella nana, Alona guttata, Anchistropus emarginatus, and Acroperus harpae (Green, 1954), but it feeds mainly on Chydorus sphaericus (Green, 1954, 1966). The peak of abundance of Chaetogaster diaphanus and Chydorus sphaericus coincide (Green, 1966). Chydoridae are also preyed upon by chironomid larvae. Ablabesmya monilis L. preys on Acroperus harpae and Chydorus sphaericus (Luferov, 1961). Procladius nigriventris preys on Biapertura affinis and Chydorus sphaericus (Luferov, 1961). Procladius choreus attacks Chydorus sphaericus (Luferov, 1961). Utricularia captures Ch. sphaericus, Acroperus harpae, and Eurycercus lamellatus (Rodionova, 1959).

Szlauer (1965) examined the ability of female Chydorus sphaericus to escape from an imitation of a predator in the form of a glass tube pushed toward them at a speed of 1 cm/sec (i. e., at a speed slightly greater than that of the chydorid). If the tube was 1 mm wide, 68% of the crustaceans succeeded in escaping, but only 34% were able to escape if the tube was 2.8 mm wide or wider.

We observed Pleuroxus uncinatus and Chydorus sphaericus resting on the tentacles of Hydra; the tentacles did not contract and the hydra made no attempt to swallow the crustaceans. In fact, they swam away without any visible signs of damage. Two Rotifera of the genus Brachionus were found on a specimen of Pleuroxus trigonellus collected on 15 July 1965 near Borok in the Rybinsk Reservoir. An egg of the rotifer was attached to the endite of leg II near the longest setae in the concave part of the endite opposite the hook-shaped setae of leg III. The crustacean was unable to discard the egg by movements of the legs. The rotifer Proales was found in the brood chamber and on the body of Eurycercus lamellatus (Rybinsk Reservoir). Vorticella microstoma Ehrenb. is often found on E. lamellatus (on the lower part of the head, Rybinsk Reservoir, determination by Mordukhai-Boltovskoi). Peritricha were found on the valves of Leydigia, Pleuroxus, and Monospilus (Sebestyén, 1947). Vorticella chydoridicola Šrámek-Hušek, 1946 was found attached to

Disparalona rostrata (Šrámek-Hušek, 1946). On Chydorus sphaericus, Green (1957) found Spirobacillus cienkowskii Metchnikoff, 1889, the green alga Stylosphaeridium inhaerens (Bachman) Pascher, and the protozoan Epistylis helenae Green, 1957, Intrastylum invaginatum Stokes, and Vorticella octava Stokes. The rotifer Collotheca settles on Monospilus dispar (Sebéstyen, 1947).
147 Coelosporidium chydoricola Mesnil and Marchoux, 1897 is an endoparasite of Chydorus sphaericus (Mesnil and Marchoux, 1897; Chatton, 1908); Amoebidium parasiticum Cienkowski is an ectoparasite of Chydorus (Chatton, 1908); Botellus typicus parasitizes in the genitalia of Chydorus sphaericus (Chatton, 1908). Endoparasitic phycomycetes have been found in Leydigia leydigi (Šrámek-Hušek et al., 1962). The fungus Blastulidium is an endoparasite of Chydorus sphaericus (Chatton, 1908). Overgrowths of diatoms and green algae have also been found (Figures 177 and 178). Since Chydoridae molt every 2–3 days, overgrowths of algae probably occur in specimens whose molt was delayed. Anchistropus feeds on Hydra (monophagous).

Bening (1938) considers migratory birds as vectors of resting eggs of Chydoridae. The difference between the American and Afro-Eurasian fauna of Chydoridae corresponds to a difference in bird migrations. Mukhamediev (1951) considers the following possible methods of spread of Chydoridae: transport of ephippia by migratory birds, running water, wind, transport with rice seeds, and gradual penetration over a long time. Mukhamediev (1965) holds that high-altitude air currents are a major factor in the transfer of ephippia over long distances. The importance of birds in the distribution of Chydoridae is also supported by the fact that eggs of Alona guttata remained alive after passing through the intestine of ducks (Proctor, 1964).

The littoral life of Chydoridae can thus be explained by their morphology
148 and the favorable conditions of food in the littoral, which is rich in fresh detritus and has an abundant flora of algae and bacteria. Chydoridae need detritus at certain stages of decomposition; this is proved by the fact that they can be cultured on batches of detritus and die if this is discontinued. Biocenotic factors are also involved, since Chydoridae consume detritus which is formed by the activity of different animals in the littoral. Another important aspect is the behavior of Chydoridae, mainly their preference for living on a substrate.

QUANTITATIVE DYNAMICS

Chydoridae hatch from ephippial eggs immediately after the thaw in water bodies which freeze (early May in the Rybinsk Reservoir). According to observations in the Volga delta, the biomass increases sharply in August and remains at a high level until late fall. The biomass is still large in October–November, but most females are ephippial, and the ice sheet develops when the population is in this state. The above data show that the life cycle of the Chydoridae has no characteristics which may cause major fluctuations of their biomass. After hatching from the ephippia in the spring,

(147)

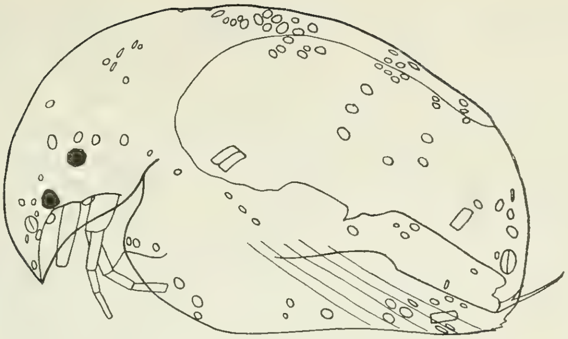


FIGURE 177. Acroperus harpae covered with diatoms (mainly Cocconeis pediculus Ehr.) (Sutka River, 11 August 1962, preparation 206)

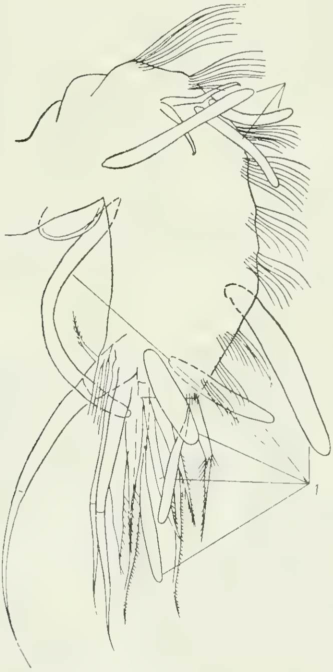


FIGURE 178. Leg I (left leg, inner view) of female of Pleuroxus trigonellus overgrown with the green alga Filarszkia cylindrica Korschikov (1). Width of cell to 9 μ, length to 120 μ (Cherepovets Reservoir, 8 August 1963).

however, their biomass increases very slowly and fluctuates, especially in the different species. These fluctuations are apparently caused by environmental factors. The increase in the biomass in summer lags far behind the rise in temperature. No marked changes in pH have been found in the littoral of the Rybinsk Reservoir during the vegetation period. We assumed that seasonal changes in the composition of detritus may affect their biomass and attempted to find seasonal changes in the proportion of amino acids in the detritus by paper chromatography. The results did not show any distinct seasonal changes. The seasonal changes of the biomass of Chydoridae apparently depend on two factors: growth of the biomass under the favorable influence of the littoral vegetation, and the action of predators, e. g., Naididae, Hydroidea, mites, and fishes in the littoral of the Rybinsk Reservoir. In the first half of summer, the vegetation is too little developed to protect the Chydoridae against the predators. The biomass of Chydoridae later increases rapidly in the vegetation and remains high until the formation of ice, thus ensuring a large number of resistant eggs (Smirnov, 1963b).

The active life of the Chydoridae lasts from May to November in the Volga upper reservoirs. The abundance of Chydoridae begins to increase rapidly in mid-July and decreases in October in years of high water, when there is a rich vegetation. This was found in the high-level year of 1962 in the littoral of the Rybinsk Reservoir near Borok (Figures 179 and 180). In 1962, a year of high water level, Eurycercus lamellatus formed the greater part of the biomass of Chydoridae. We studied particularly the seasonal changes in the population of E. lamellatus (Figure 180). The greater part of the population in May consisted of young individuals which hatched from ephippial eggs. There was an increase in the proportion of large females in June and July. This persisted until August, but with the addition of numerous young forms. The proportion of young forms increased sharply in early September. There was a decrease in the young forms from mid-September. These forms were absent in late October and early November. The appearance of males in mid-August (together with ephippial females) and their reappearance after an interruption in mid-September prove the dicyclic life of the population of E. lamellatus in the Rybinsk Reservoir. Males were scarce in August. Numerous males appeared from mid-September, a time when all females became ephippial. The reproductive capacity of the population can be estimated by the number of parthenogenetic eggs per 100 females. There were 24 such eggs per 100 females in June (including young forms). The largest number of eggs per 100 females (90) was found in July. The number of juveniles increased markedly in August. From early October the females contained only ephippial eggs. The whole biomass of Chydoridae in the Rybinsk Reservoir and that of the dominant form E. lamellatus reached a peak in late July and August, and then decreased slightly (Smirnov, 1962b). This is also the population dynamics of Pleuroxus trigonellus (Smirnov, 1964), P. truncatus, and Chydorus sphaericus. In contrast, the biomass of Acroperus harpae increased constantly until late fall, and more distinctly from late August. In laboratory cultures of Alona costata, Pleuroxus aduncus, and P. striatus the formation of ephippia began only in August; in cultures of P. truncatus, males appeared in late June. Kurz (1875) obtained males in cultures in early summer.

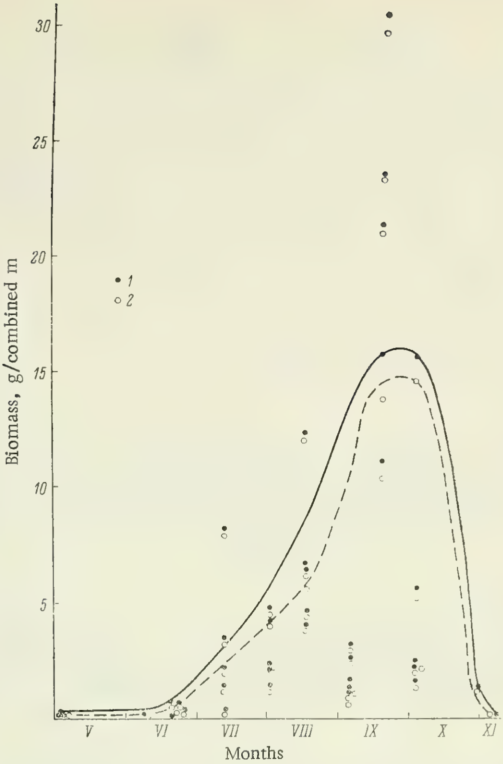


FIGURE 179. Seasonal dynamics of Chydoridae (at high water level in the Rybinsk Reservoir in 1962):

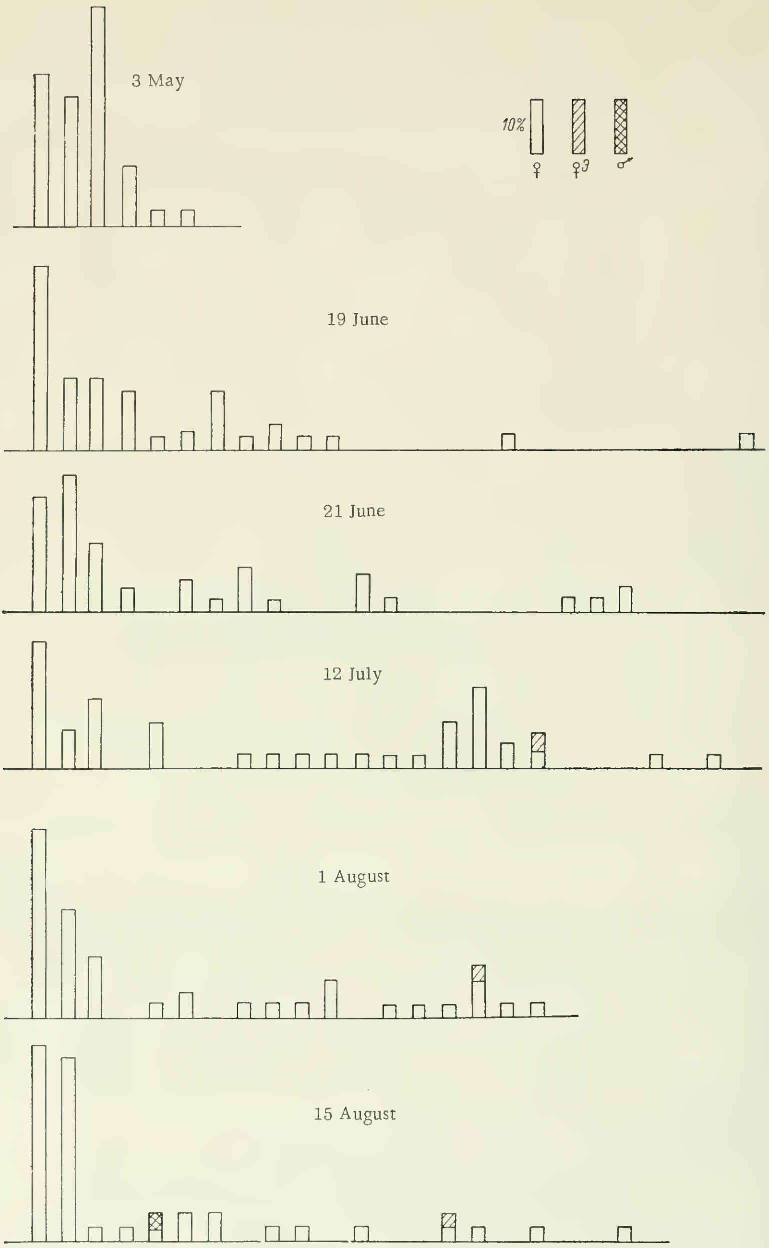
1 — all Chydoridae; 2 — Eurycercus lamellatus.

Lebedeva (1961) cultured Eurycercus lamellatus in containers which were placed in the littoral of the Rybinsk Reservoir and were covered with silk gauze. There was a decrease in the growth and reproduction rate between June and August under these conditions.

We found in similar experiments that E. lamellatus grew for 21 days until the production of young in May—June; the corresponding periods were 15 days in July and 24 days in late August — September, when some of the females formed ephippia. In early October, the juveniles became frozen without reaching maturity.

The changes of some environmental factors in the littoral were also considered to help explain the seasonal changes in the abundance of Chydoridae. The temperature was 18—20°C already in mid-June, i. e., long before the increase in the abundance of Chydoridae. The temperature dropped to 12—14°C in late August and September but the numbers of Chydoridae increased. The mass formation of ephippia in early October was preceded by a period in which the temperature was about 12°C. The vegetation developed long before the mass growth of Chydoridae, i. e., in mid-June. The role of the vegetation for the Chydoridae is mainly indirect and

(150)



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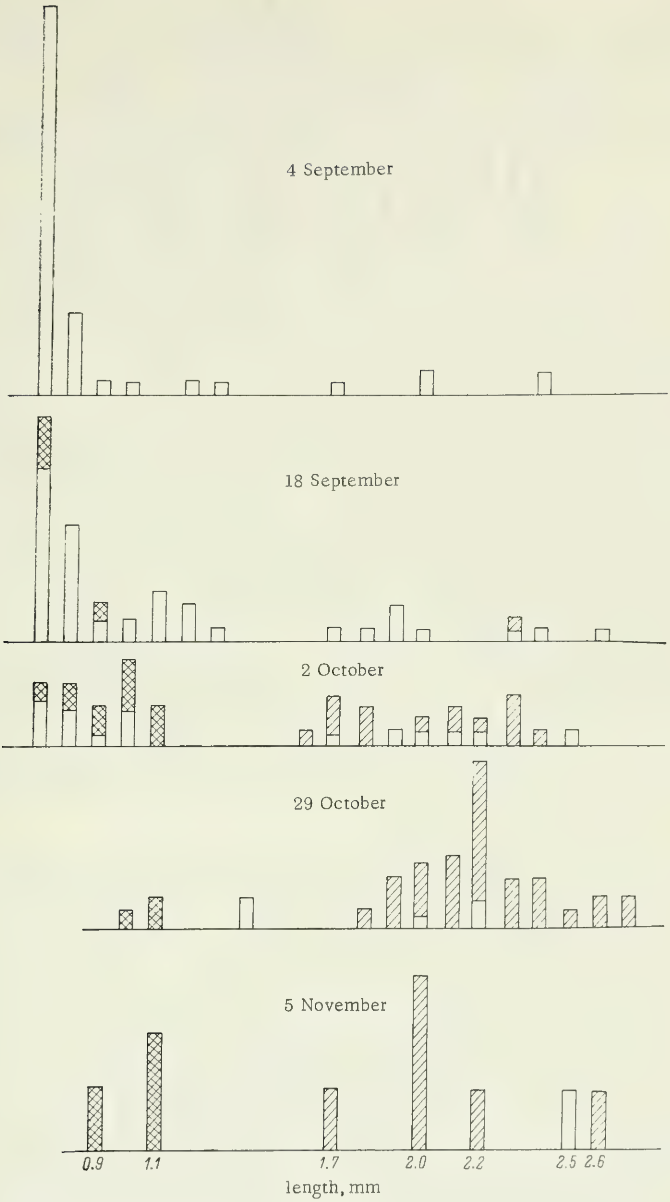

FIGURE 180. Size and sex ratio of a population of Eurycercus lamellatus in 1962:

3 May — females developing from ephippial eggs; 19 June—24 eggs per 100 individuals; 21 June — 53 eggs per 100 individuals; 12 July — 90 eggs per 100 individuals; 1 August — 50 eggs per 100 individuals; 15 August — 28 eggs per 100 individuals; 4 September — 30 eggs per 100 individuals; 18 September — 50 eggs per 100 individuals; 2 October — 5 November — ephippial eggs.

consists in the development of a specific phytoplankton, the formation of overgrowths, the accumulation of a special quality of detritus, and protection against wave action and predators. The abundance of Chydoridae depends also on the population dynamics of their predators. Observations in the 152 Volga reservoirs show that the biomass of Chydoridae attains a peak in the second half of summer; these studies were made mainly in August.

Some Chydoridae reach a high density (thousands per combined meter). Examples are Alona guttata, Pleuroxus truncatus, and Chydorus sphaericus up to 420–1,400; Acroperus alonoides up to 331; A. harpae, A. elongatus, Alona quadrangularis, Chydorus gibbus, Monospilus dispar, and Rhynchotalona falcata 100–227; Alonella exigua 60; Eurycercus lamellatus 58. Other species have a low density, e. g., Alonella nana, not more than 4.

Tables 13–16 show the biomass of Chydoridae in reservoirs, rivers, and lakes in eastern Europe. Some species which had not been recorded before from these areas were found after a thorough study (Smirnov, 1963a).

The data on the rivers of the Volga pool of the Rybinsk Reservoir permit comparison of the composition and quantity of the littoral fauna of the tributaries with those of the littoral of the reservoir. Samples were taken from the Sutka River 9 km from the mouth, from the Ladka River 5 km from the mouth, and from the rivers Il'd, Shumorovka, and Sunozhka upstream from the mouth. The length of these rivers in km is as follows; Sutka 50; Il'd 30; Shumorovka 15; Sunozhka 3; Ladka 12. The width of these rivers at the points of sampling is as follows: Sutka several tens of meters; Il'd about 10 m; Sunozhka and Ladka about 1 m. The rivers of the Volga pool of the Rybinsk Reservoir differ from the reservoir in the presence of large numbers of Leydigia leydigi (found in the rivers Il'd, Shumorovka, and Ladka). The biomass of L. leydigi was 145 mg/m^3 at a density of 2,080 organisms/m^3 (Ladka River). All Cladocera found in the rivers (Table 17) are found also in the Upper Volga reservoirs, but many species found in the reservoirs are apparently absent in the rivers (e. g., Monospilus dispar and Acroperus elongatus).

The Chydoridae of Lake Baikal are of particular zoogeographical and phylogenetic interest. During their research of the Baikal fauna, Vereshchagin and Kozhov did not find any Chydoridae. They considered the Cladocera found in the lake as introduced forms.

Vasil'eva and Smirnov (1969) studied the Chydoridae collected in Lake Baikal by the expeditions of the Biological-Geographical Institute of Irkutsk University, headed by Professor M. M. Kozhov. The specimens were collected near the Baikal Cellulose Enterprises between the mouth of the Utulik and the Murina and in the inlet Bol'shie Koty.

Seven new species were found in Lake Baikal; 5 of them were placed in the new genus Kozhowia. All these 7 new species are endemic and have not been found outside Lake Baikal: Kozhowia baicalensis, K. primigenia, K. gajewskayae, K. kozhowi, Alona labrosa, and A. setosocaudata. We describe below another endemic species of the genus Kozhowia.

The following Chydoridae have also been found in Lake Baikal: Alona guttata guttata, Chydorus sphaericus sphaericus, and Ch. piger piger.

TABLE 26. Maximum density of Chydoridae (specimens/m^2) in the summer in the littoral of Lake Baikal between the rivers Utulik and Murina (after Vasil'eva and Smirnov, 1969)

Date	Chydorus piger		Alona setosocaudata		A. labrosa		Kozhowia baicalensis	
	sand	stones	sand	stones	sand	stones	sand	stones
1964 July	–	2,292	40	27	–	18	–	34
August	–	108	–	18	–	18	–	9
1965 June	20	100	80	28	–	20	24	–
July	–	3,120	40	20	40	70	–	–
August	60	760	300	230	700	300	340	80
October	–	–	60	50	–	–	10	100
1966 June	80	320	28	480	320	80	–	–
July	–	98	–	630	–	40	120	20
August	–	–	–	–	260	350	120	1,280

There are some data on the density and distribution of Chydoridae in Lake Baikal (Tables 26 and 27; Vasil'eva and Smirnov, 1969). Chydorus piger is the most common species. The density of Kozhowia gajewskajae and K. kozhowi is far lower than that of the other species. The densities are maximum in July-September. Chydorus piger is most 153 abundant at a depth of up to 5 m (Table 27), and Alona labrosa, A. setosocaudata, and Kozhowia baicalensis up to 10 m. Chydoridae are absent in the immediate vicinity of the shore. There is no vegetation, and the mainly stony bottom is washed by waves. In winter, freezing and movement of ice kill the fauna in the littoral of the lake. Chydoridae are generally found from a depth of one meter. In other lakes and reservoirs, they live in the littoral. There is thus a vertical displacement of the littoral fauna in Lake Baikal, as in the White Sea (Zenkevich, 1947:153; 1963:164).

TABLE 27. Maximum density of Chydoridae (specimens/m^2) in the open water of Lake Baikal at different depths in the littoral between the rivers Utulik and Murina (after Vail'eva and Smirnov, 1969)

Date	Chydorus piger			Alona setosocaudata			Kozhowia baicalensis			Alona labrosa			Kozhowia kozhowi
	1–2.5 m	3–5 m	6–10 m	1–5 m	6–10 m	10 m	1–5 m	6–10 m	10 m	1–5 m	6–10 m	10 m	2–10 m
1964 July	2,892	252	20	27	40	–	84	30	40	18	–	–	Single
Aug.	–	–	–	–	18	6	9	6	6	–	–	18	"
1965 June	100	–	–	80	–	–	25	–	24	20	–	–	"
July	3,120	–	–	40	–	–	25	–	–	70	–	40	"
Aug.	760	60	–	300	40	40	20	30	–	300	70	–	400
Oct.	–	–	–	60	40	40	100	10	10	–	–	–	Single
1966 June	420	160	320	28	–	–	–	–	–	80	320	–	"
July	–	–	–	–	–	–	10	120	–	–	20	–	"
Aug.	40	980	–	266	630	–	1,280	20	–	260	450	–	"

Thirty-one species and subspecies of Chydoridae, all of them of the fauna of the Euro-Siberian Subregion of the Palearctic, have been found in water bodies around Lake Baikal. Alona guttata and Chydorus sphaericus occur both in Lake Baikal and in water bodies around the lake. Daday (1913) found the following species in the littoral of Lake Kosogol and in water bodies in the vicinity: Ch. sphaericus, Alonella exigua, A. nana, Alona costata, A. guttata, A. quadrangularis, A. rectangula, Disparalona rostrata, Biapertura affinis, B. intermedia, Acroperus harpae, and Eurycercus lamellatus.

Dulma Auyur (1965) found the following species in lakes in northwestern Mongolia: Pleuroxus uncinatus, P. truncatus, Acroperus harpae s. str., Graptoleberis testudinaria, Disparalona rostrata, Leydigia leydigi, Alona guttata, A. costata, A. quadrangularis, Biapertura affinis, Chydorus sphaericus, Pseudochydorus globosus, and Eurycercus lamellatus. The following were found in Lake Ochrida: Disparalona rostrata, Alonella exigua, A. excisa, A. nana, Chydorus sphaericus, Pseudochydorus globosus, Acroperus harpae, Camptocercus rectirostris, Alona guttata, A. rectangula, Alona sp. (Stanković, 1960; Točko, 1966), Eurycercus lamellatus, Graptoleberis testudinaria, Pleuroxus trigonellus, Biapertura affinis, and Monospilus dispar (Green, 1960).

In Sphagnum cuspidatum (west shore of the Rybinsk Reservoir, 5 July 1960) we found Alonella excisa and Chydorus sphaericus; among S. apiculatum (west shore of the Rybinsk Reservoir, 10 October 1960) we found Ch. sphaericus; in a sphagnum swamp on the north side of the Rybinsk Reservoir (30 September 1962) we found Ch. sphaericus, Alona guttata, and Alonella exigua; among S. riparium (quarry on a sphagnum swamp, Moscow Region) Smirnov (1961b) found Acroperus harpae, Chydorus sphaericus, Graptoleberis testudinaria, and Disparalona rostrata.

Chydoridae have also been found in groundwaters. Motas and Orghidan (1948) found Alona quadrangularis, Leydigia leydigi, and Chydorus sphaericus in groundwaters. Chappius (1922) found Alona rectangula and Leydigia leydigi in groundwaters. Spandl (1926b) recorded Pleuroxus truncatus, Alona costata, and Camptocercus rectirostris from groundwaters. Moniez (1889b) found Pleuroxus trigonellus, P. truncatus, Chydorus sphaericus, Alona costata, Camptocercus rectirostris, and Leydigia acanthocercoides in groundwaters.

According to Šrámek-Hušek (1962), the biocenoses which include Chydoridae belong to the community Daphnio-Chydoridion litorale Šrámek-Hušek, 1962 (which includes Monospilion (Monospiletum Lityński, 1922:42). In Central Europe, this community contains the associations Ceriodaphnio-Chydoretum sphaerici Šrámek-Hušek, 1962; Ceriodaphnio-Chydoretum ovale Šrámek-Hušek, 1962;
154 Alonopsetum elongatae Lityński, 1922:36, 42; Šrámek-Hušek, 1943:13–16, 18–21.

Goulden (1966a) analyzed the communities of Chydoridae on phylogenetic principles which determine the structure of communities.

Whiteside and Harmsworth (1967) determined and counted the remains of Chydoridae in the surface bottom sediments of 20 lakes in Denmark and 14 lakes in Indiana, U. S. A. Using a computer, they calculated the index of species diversity for each lake according to the Shannon function $H = -\sum p_i \log_2 p_i$, the coefficients of correlation between these indexes and the magnitude of primary production, and between these indexes and transparency. Of the two methods for the determination of the maturity of a community, i. e., 1) the determination of the P/B coefficient, the magnitude of which is lower in more mature communities, and 2) the determination of the species diversity, the authors selected the determination of the indexes of species diversity with reference to the primary production and transparency. It was assumed that the order of magnitude of the annual primary production corresponds to the level of maturity of the lake, so that a less productive lake is considered as less mature. For the Danish lakes, a negative correlation was obtained between the indexes of species diversity and those of primary production; this negative correlation is not derived from the information theory, which states that a more mature community should have a more complex structure and accordingly a higher index of species diversity. The discrepancy between the theory and the results obtained may appear either because the theory is not applicable or the magnitude of primary production cannot be compared with the degree of maturity of the lake community. Only the primary production of phytoplankton was measured, but in some cases macrophytes may have a major part in the primary production. In view of this discrepancy the authors propose a theory according to which biological diversity is proportional to the diversity of the environment. In fact, a positive correlation was found between the index of species diversity and the transparency. The authors think that the species diversity of Chydoridae depends mainly on the complexity of the biotope (vegetation), and that the diversity of the environment increases with depth.

GEOGRAPHICAL DISTRIBUTION

The distribution maps are based on the literature and on our own unpublished data. Most Chydoridae do not have a very wide distribution. Examination of the records of Chydoridae shows that there are different faunas in the various zoogeographical regions, but that many species occur in two or three regions. Some Chydoridae are found on all continents. To this group belong Chydorus sphaericus, Ch. barroisi, Pseudochydorus globosus, Pleuroxus aduncus, Alonella excisa, Alona guttata, A. rectangula, Biapertura affinis, B. karua, B. intermedia, Graptoleberis testudinaria, and Leydigia leydigi. Most species of Chydoridae, however, have a restricted distribution which varies greatly in form and area. Species with a small distribution are Pleuroxus letourneuxi, Tretocephala colletti, and Saycia cooki. Eurycercus glacialis has a circumpolar distribution. Chydorus hybridus, Alonella dentifera, A. dadayi, Alona monacantha, and

Oxyurella longicaudis have a wide latitudinal distribution. Dadaya macrops and Dunhevedia serrata have a pantropical distribution.

The Chydoridae of the Holarctic Region have been studied in detail. The Chydoridae of North America have been studied mainly by Birge (1879 etc.) and Frey (1959 etc.). The fauna of Chydoridae of the Holarctic Region includes the genera Rhynchotalona (with the single species Rh. falcata) and Anchistropus (two species), and the species Pleuroxus uncinatus, Chydorus gibbus, Oxyurella tenuicaudis, Acroperus elongatus, Camptocercus lilljeborgi, and Eurycercus glacialis. There are probably unrecorded species from Asia because the family has been little studied there; such species are Chydorus pigroides, Ch. phintonicus, Alona weltneri, and A. protzi. The fauna of the Holarctic Region consists of about 72 species. Species known so far only from the Palearctic Region consists of about 72 species. Species known so far only from the Palearctic Region are Pleuroxus truncatus, P. letourneuxi, Anchistropus emarginatus, Alona karelica, Tretocephala ambigua, Camptocercus fennicus, and the endemic species of the Baikal area, viz., Kozhowia baicalensis, K. primigenia, K. gajewskajae, K. kozhowi, K. brevidentata, Alona setosocaudata, and A. labrosa.

The fauna of the Nearctic Region contains the species Alonella pulchella, Anchistropus minor, Leydigia trichura, L. fimbriata, and Camptocercus oklahomensis. Most of Europe and the USSR belongs to the Euro-Siberian Subregion, where the following species occur: Rhynchotalona falcata, Anchistropus emarginatus, Pleuroxus truncatus, P. uncinatus, Alona weltneri, A. karelica, A. protzi, Chydorus pigroides, Ch. gibbus, Acroperus elongatus, Camptocercus fennicus, C. lilljeborgi, Eurycercus lamellatus, Oxyurella tenuicaudis, and the 7 endemic species of the Baikal area. Some of these species spread into zoogeographical subregions further south. Alona milleri may be found in the extreme southeast of the USSR.

The Arctic Subregion is characterized by Eurycercus glacialis. This species was found on the northern coast of Western Europe (including the Netherlands) together with a few glacial relict species (Beijerinck, 1931). The Mediterranean Subregion is characterized by Pleuroxus letourneuxi and Chydorus phintonicus.

Most of the USSR belongs to the Euro-Siberian Subregion. Some species of its fauna are also found in more southern subregions, parts of which are in the USSR. Into the southern parts of the USSR spread Mediterranean species (Transcaucasia) of the Central Asian Subregion (Kazakhstan, Turkmenia, Uzbekistan, Tadzhikistan, and Kirgizia, Figure 181). The Central Asian Subregion is very large. The Chydoridae of this area were studied mainly by Mukhamediev (1949—1965) and Ulomskii (1959). This fauna contains southern forms of warm water, e. g., Chydorus barroisi, Biapertura karua, Alona davidi, A. cambouei, A. archeri, and Chydorus herrmanni. The Maritime Territory certainly has a specific fauna, to judge from the occurrence in the Amur basin of a species of Alona which differs from the other species of this genus. The fauna of Chydoridae of the Maritime Territory is unknown; it probably contains some species found further south, in East China.

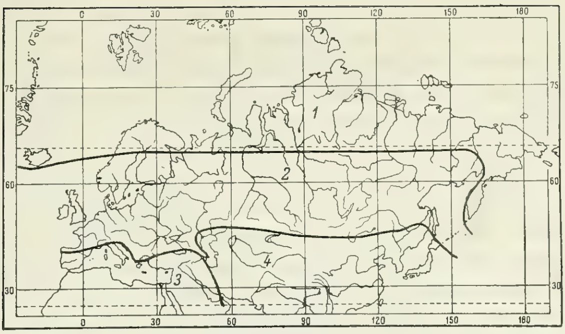

FIGURE 181. Zoogeographical subregions of the USSR according to the records of Chydoridae:

1 – Arctic; 2 – Euro-Siberian; 3 – Mediterranean; 4 – Central Asian.

Differences in latitude appear in the distribution of many Chydoridae. Of particular interest is the distribution of Chydoridae in the basins of large rivers flowing from the North. We found no differences in latitude in the fauna of Chydoridae of the Volga Basin (Smirnov, 1963a). The only exception is the presence of Alona cambouei in the Volga delta (Kosova, 1965); the Volga delta therefore belongs to the Central Asian Subregion.

The Chydoridae of the Ethiopian Region were studied by Sars (1895, 1916), Daday (1907, 1908b, 1910a, 1910b), Gurney (1904a, 1911), Gauthier (1929, 1930, 1937, 1939), Brehm (1912, 1930, 1934a, 1935a, 1939a, 1951a, 1958a, 1959a, 1960b), Fryer (1956, 1957), and Harding (1942, 1957a, 1957b, 1961). To this fauna belong Pleuroxus toumodensis, Alona capensis, A. harpularia, A. arcuata, A. crassicauda, A. striolata, A. holdeni, A. cannellata, A. hardingi, Tretocephala colletti, Leydigia macrodonta, and L. microps. There are about 66 species in the Ethiopian Region.

The Chydoridae of the Indo-Malay Region were studied by Daday (1898), and Brehm (1936b, 1952b, 1953b, 1953c). Alona archeroides and Indialona ganapati occur only in the Indo-Malay Region. There are about 43 species in this region.

The Chydoridae of Australia and New Zealand were studied by King (1853, 1866), Sars (1886, 1888, 1895, 1896c, 1904a), Henry (1919, 1922), Brehm (1928, 1931, 1932), and Gurney (1927). The fauna of the Chydoridae of Australia contains the endemic genus Saycia with the single species
156 S. cooki, and the species Alonella jugosa, A. reticulata, A. unispina, Alona kendallensis, A. clathrata, A. microtata, A. abbreviata, A. macrocopa, Biapertura rigidicaudis, Oxyurella wallaciana, and Leydigia laevis, altogether about 45 species.

The Chydoridae of South America were studied by Richard (1897b), Sars (1901), Daday (1902, 1905), Brady (1906, 1913), Brehm (1952b, 1953a, 1935a, 1936a, 1937, 1938a, 1939b, 1956, 1957), Delachaux (1919), Harding (1955, 1957b), and Löffler (1961b). The genus Leydigiopsis with the species L. curvirostris, L. brevirostris, L. megalops, and L. ornata only occurs in the Neotropical Region. The fauna of this region contains other species which do not occur elsewhere, viz., Chydorus dentifer, Ch. godeti, Dunhevedia odontoplax, Alonella lineolata, Alona subantarctica, A. pseudanodonta anodonta, A. parva, Leydigia schubarti, L. ipojucae, Euryalona fasciculata, and E. brasiliensis. There are about 58 species in this region.

De Costa (1964) in a quantitative study of fossil Chydoridae in surface sediments of lakes in the Mississippi basin (from 48° to 30° N), distinguished between northern species (which predominate north of 39° N), southern species (which predominate south of 32° N), and eurytopic species. To the northern species he assigned Eurycercus lamellatus, Alonella excisa, Alona excisa, Alona quadrangularis, and Acroperus harpae. To the southern species he assigned Biapertura karua, Pleuroxus hamatus, Euryalona occidentalis, and Leydigia acanthocercoides. The eurytopic species are Pleuroxus denticulatus, Pseudochydorus globosus, Alona rectangula, Camptocercus rectirostris, and Leydigia leydigi. The southern and northern species could not form large populations for more than a year outside their limits of latitude. Temporary development of suitable conditions may occur outside the main range. Evidence of such temporary development in the past has been found in the form of fossils in bottom sediments (De Costa, 1964).

Some species of Chydoridae have a subendemic distribution (Kryzhanovskii, 1965:6).

Birds may cause an exchange of fauna between areas on their migration route by transporting resistant eggs. Thus, Alona quadrangularis, A. costata, and Leydigia acanthocercoides are found in the fauna of the Holarctic, Ethiopian, Indo-Malay, and Neotropical regions. Kurzia latissima occurs in the Holarctic and Neotropical regions. Chydorus piger is known from the Palearctic, the Ethiopian, and the Neotropical regions. Pleuroxus laevis and Dunhevedia crassa occur in the Holarctic, Ethiopian, and Australian regions. Pleuroxus hamatus occurs in the Holarctic, Ethiopian, and Indo-Malay regions. Pleuroxus striatus, P. trigonellus, Alonella exigua, A. nana, Disparalona rostrata, Monospilus dispar, and Camptocercus rectirostris occur in the Holarctic and Ethiopian regions. Alona archeri occurs in the Central Asian Subregion and in the Indo-Malay and Australian regions. In the Ethiopian and Indo-Malay regions are found Chydorus parvus and Ch. herrmanni (which also occurs in the Central Asian Subregion). Oxyurella singalensis occurs in the Ethiopian and Indo-Malay regions. In fact, the migration routes of birds do pass through these regions. Transport by birds may explain the occurrence of the following species in the Nearctic and Neotropical regions: Chydorus hybridus, Alonella dentifera, A. dadayi, Alona monacantha, and Oxyurella longicaudis; this may also be the reason for the presence of Chydorus eurynotus, Dadaya macrops, and Kurzia longirostris in the Ethiopian, Indo-Malay, Australian, and Neotropical regions, and of Euryalona orientalis, Leydigia propinqua,

TABLE 28. Comparison of the characters of male and female Chydoridae (– no data)

Subfamily and species	Length of adults, mm		No. of anal denticles		No. of basal denticles	
	♀	♂	♀	♂	♀	♂
Eurycercinae						
Eurycercus lamellatus	4	1.3	135	121	2	2
E. glacialis	6	2	91	–	2	2
Chydorinae						
Chydorus sphaericus	0.5	0.4	10	0	2	1
Ch. ovalis	0.6	0.5	15	17	2	2
Ch. pigroides	0.47	0.32	12	10	2	1
Ch. piger	0.46	0.45	9	–	2	2
Ch. gibbus	0.5	0.45	10	10	2	1
Ch. barroisi	0.4	0.3	9	9	2	1
Ch. eurynotus	0.47	0.32	8	6	2	1
Pseudochydorus globosus	0.7	0.55	30	8	2	2
Pleuroxus laevis	0.65	0.5	18	0	2	2
P. striatus	0.8	0.54	21	13	2	2
P. hamatus	0.6	0.36	14	12	2	2
P. denticulatus	0.6	0.36	12	3	2	2
P. aduncus	0.66	0.46	12	0	2	1
P. trigonellus	0.6	0.5	14	0	2	1
P. uncinatus	0.65	0.56	13	0	2	1
P. truncatus	0.65	0.5	20	0	2	2
P. procurvus	0.6	0.39	16	0	2	2
Alonella excisa	0.45	0.3	10	0	2	2
A. exigua	0.4	0.3	10	0	2	2
A. nana	0.26	0.24	6	5	2	1
Disparalona rostrata	0.5	0.45	13	0	2	0
Anchistropus emarginatus	0.46	0.38	12	12	2	1
Dunhevedia crassa	0.55	0.36	18	14	1	0
Aloninae						
Alona, 17 species	0.35–1.0	0.25–0.75	35–9	16–0	1	1–0
Oxyurella tenuicaudis	0.6	0.45	20	0	1	1
O. singalensis	0.9	0.5	14	3	3–4	1(2?)
Rhynchotalona falcata	0.55	0.4	5	0	1	1
Leydigiopsis curvirostris	0.85	0.62	20	16	1	1
Graptoleberis testudinaria	0.7	0.5	–	0	1	0
Euryalona occidentalis	1.0	0.72	22	22	1	1
E. colletti	1.1	0.8	22	17	1	1
E. fasciculata	0.9	0.6	22	20	1	1
Kurzia latissima	0.6	0.4	12	–	1	1
Acroperus harpae	0.8	0.6	Reduced	0	1	1
A. elongatus	0.85	0.65	17	0	1	1
Camptocercus rectirostris	1.2	1.0	17	0	1	1
C. lilljeborgi	1.1	0.7	28	24	1	1
C. oklahomensis	1.0	0.6	Reduced	0	1	1
Monospilus dispar	0.47	0.42	7	0	1	1
Leydigia leydigi	1.0	0.7	Reduced	Reduced	1	1
L. ciliata	0.97	0.7	"	"	0–1	0
L. laevis	0.6	0.3	"	"	0	0
L. acanthocercoides	1.1	1.0	"	"	0	0
L. australis	0.84	0.46	"	"	0	0

Indialona globulosa, and Biapertura pseudoverrucosa verrucosa in the Ethiopian, Indo-Malay, and Neotropical regions. Brehm (1908) records cases of distribution of some species of Chydoridae in South America and in Australia, Java, Sumatra, and Ceylon. Further studies have shown that these species occur also in Africa and Asia.

It is interesting that species of Chydorinae and Aloninae with a denticulate labral plate occur between 50° S and 50° N. There are morphological differences between some species in different distribution areas (Frey, 1965b). Thus, the claw of the male of Alona costata has no basal spine in Europe but it has such a spine in North America.

PHYLOGENY OF CHYDORIDAE

Oligomerization of structures is found in the Chydoridae and also in comparison with more primitive Cladocera. This suggests the trend of evolution of Chydoridae according to the theory that primitive forms have a greater number of homologous structures (Dogel', 1954). The Eurycercinae thus appear as the most ancient subfamily; it is followed by the Sayciinae, Chydorinae, and Aloninae. The primitive subfamilies contain only a few species. The Eurycercinae consist of a single genus with three species, the Sayciinae of one genus with a single species, while the Aloninae contain more than 100 species. In Eurycercus glacialis, 158 the most primitive species, the epipodites have no processes, as in the Sididae and Daphniidae. Parallel with the oligomerization, there is a change in size. The largest species belong to the Eurycercinae (Eurycercus glacialis is 6 mm long), and the species of Sayciinae reach lengths of 1.7 mm. In contrast, the species of Chydorinae and Aloninae are only 0.2 to 1.2 mm long. It is important to mention that the males surpass the females in the oligomerization of some structures (Table 28). The number of anal denticles is always smaller in the male than in the female. The number of basal denticles is usually smaller in the male than in the female. The male is always smaller than the female. This phenomenon is also known in other Arthropoda. Beklemishev, when discussing the number of genital openings in the Pantopoda, stated that evolution is toward oligomerization of the number of openings, and that the males surpass the females in this respect (Beklemishev, 1964:357). The trend of evolution can thus be determined by comparing the number of homologous structures in different species and also by comparing the two sexes. The primitive forms have no distinct vertical or lateral keels; these are apparently recent developments.

The legs act uniformly in Eurycercus, Chydorinae, and in some Aloninae despite later oligomerization. In some specialized Aloninae, however, the legs function differently. In Camptocercus, only the exopodite of leg V makes rhythmic vibrations. We name this the second morphofunctional type. The abdominal part of the body becomes longer and gives greater freedom of movement to the postabdomen, so that the animal can clean not only the legs but also the outer surface of the valves; it also facilitates removal of obstacles. The valves are longer in this morphofunctional type. In the third morphofunctional type, viz., Graptoleberis, Rhynchotalona, and Monospilus, the legs do not make rhythmic vibrations. Special morphofunctional types of legs (second and third type) are found in Aloninae in which oligomerization is most advanced. In Camptocercus, leg IV resembles leg III; This has not been observed in primitive Chydoridae. This phenomenon is functionally determined and is a late trend in the evolution of the morphological type of the legs. Another trend of evolution is observed in the third morphofunctional type of the legs. In the two species of this type, which inhabit the open littoral, leg II has a very wide, semicircular gnathobase. The ocellus also has a greater role in these species. Graptoleberis testudinaria, which also belongs to the third type of legs, is adapted for crawling on plants; this is reflected in the characteristic form of this species.

These considerations agree with the zoogeographical data. Eurycercus glacialis, the most primitive species, is restricted to the Arctic Subregion. The closely related E. lamellatus, which is smaller and has processes on the epipodites and fewer setae on the exopodites, is distributed throughout the Holarctic Region and probably developed from E. glacialis (or a related form). The restricted distribution of E. polyodontus and E. lamellatus minuta is important; they may be considered as the product of further evolution. Another primitive species, Saycia cooki, is restricted to Australia and New Zealand. The importance of zoogeographical data is proved also by the case of Acroperus elongatus and A. harpae. The legs of these two species are almost indistinguishable. A. harpae, however, shows oligomerization; the number of setae on the antennae is reduced from 8 to 7, the anal denticles have almost disappeared (they are well developed in A. elongatus), and only one seta on the concave margin of the claw is larger than the others (this point bears 2–3 spinules in A. elongatus). A. harpae has a well developed keel, which is absent in A. elongatus. The latter species belongs to the fauna of the Holarctic Region, while A. harpae s. lat., is distributed throughout the world except Australia.

The application of general concepts of cybernetics to the formulation and solution of problems dealing with self propagation gives a new interpretation of the differentiation of the sexes as a division between the permanent and operative memory of the species (Geodakyan, 1965b). According to this hypothesis, the male shows the evolutional trend of characters because its morphology precedes that of the female during evolution (Geodakyan, 1965a, 1965b; Geodakyan and Smirnov, 1969). This interpretation leads to a conclusion which may be called "rule of sexual dimorphism," i. e., if a character shows sexual dimorphism, this character finds expression phylogenetically in the male. For example, if the male is larger than the female, the species tends to become larger; conversely, if the male is smaller than the female, the trend is toward a decrease in size. A
159 review of the species of Cladocera with reference to the presence or absence of males, the frequency of the transition to bisexual reproduction, and the environmental conditions which cause this transition, leads to the conclusion that males always appear in response to changes in the environment. A transition from parthenogenetic to bisexual reproduction occurs under extreme conditions. On the other hand, parthenogenetic forms usually predominate in large water bodies, where the environmental conditions are relatively stable (Manuilova, 1965). Thus, males have disappeared in some species of Cladocera inhabiting large water bodies. Of the 25 species of Polyphemidae in the Caspian Sea, only 8 were found to have males and females with latent eggs, an indication that males have probably disappeared altogether (Mordukhai-Boltovskoi, 1965a, 1965b). Conversely, bisexual reproduction often predominates in small temporary waterbodies with unstable environmental conditions and in severe climates. Males are almost always present in populations of Alona cambouei in the warm water of rice fields (Ulomskii, 1959). Similar phenomena have been observed

in experiments with Cladocera, where a deviation from optimum conditions resulted in the appearance of males. All male Cladocera are smaller than the females. It may therefore be assumed that Cladocera show a general tendency toward a smaller size. This is supported by the fact that the primitive forms of lower crustaceans are larger. This is also true when applied to the large number of species of the orders Euphyllopoda and Cladocera. There are forms in this group which show a gradual decrease in size and in the number of legs, as well as a specialization of the legs, all in accordance with phylogenetic continuity and the smaller size of the males (Conchostraca — Sididae — Daphniidae — Eurycercus — Chydorinae). The highly specialized legs and the structure of the head pores are identical in the two sexes with the exception of leg I, which in the male has a hook for holding the female.

Without entering into details concerning the sexual function, let us compare the size, the number of anal denticles, and the number of basal spines on the claw in the two sexes (Table 28). Sexual dimorphism in the subfamily Eurycercinae consists of primary sexual characters and the smaller size of the male. In the subfamilies Chydorinae and Aloninae, the difference between the male and the female becomes more marked. In addition to the different size, there is a reduction in the anal denticles and the basal spines of the claw, and a change in the form of the postabdomen of the male. The difference in size between the two sexes is much smaller in the Chydorinae and Aloninae than in the Eurycercinae. The transition from large (primitive) species to small ones is accompanied by a reduction in the number of young to two per batch. However, the young are much larger. The length of the young, expressed as a percentage of that of the adult female, is only 26% in the primitive Eurycercus lamellatus, compared with 47—64% in the Chydorinae and 50—78% in the Aloninae (Smirnov, 1965b). Moreover, the reduction in the anal denticles, which is already present in the Eurycercinae, is more marked in the Chydorinae and Aloninae. The males of some species of Chydorinae and Aloninae even lack anal denticles. Finally, the anal denticles are strongly reduced in both sexes of some species of Aloninae (Acroperus harpae, Leydigia). It may be assumed, therefore, that species with reduced anal denticles are the final stages of phylogenetic trends in the Chydoridae. All modifications in the structure of the row of anal denticles, i.e., deviations considered as deformities, always involve a decrease in their number and size, never an increase. As far as these characters are concerned, the males of the phylogenetically older subfamilies apparently first develop characters which appear in the following (more specialized) subfamilies. Thus, the evolutional trend of characters depends on two factors, morphological relationships and the rule of sexual dimorphism. This conclusion provides a new tool for further research in evolution. In addition to the structure of the legs and the head pores, the subfamilies of Chydoridae differ in the number of basal spines on the claw. The female Eurycercinae and Chydorinae has two basal spines, the female Aloninae only one. However, there are exceptions; in the Chydorinae, the females of Dunhevedia, Dadaya, and some species of Alonella have a single basal spine; in the subfamily Aloninae, the females of some species of Leydigia have no basal spines. The rule of sexual dimorphism explains these exceptions. Since the number of basal spines on the claw of the male Chydorinae and Aloninae is often smaller
160 than in the females, these species may be considered as specialized. Leydigia is phylogenetically the most recent genus of Chydoridae. This is proved not only by the rule of sexual dimorphism, but also by morphological considerations: the exopodite of leg III of Leydigia bears 5 setae, and the other legs are also markedly specialized. All other genera of Chydoridae have 7 such setae or more.

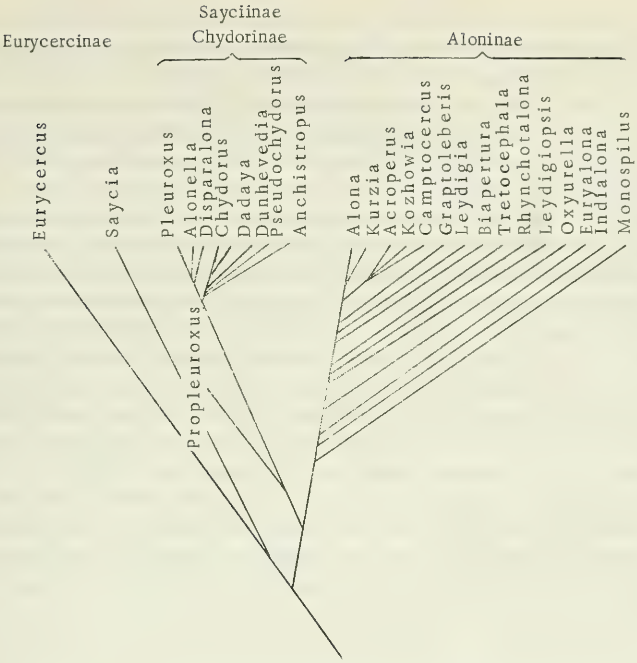

FIGURE 182. Phylogenetic relationships between the genera of Chydoridae

Some assumptions may be made on the biological significance of these changes. With a decrease in size there is an increase in surface, which improves both the gas exchange and the buoyancy. Chetverikov (1915) assumed that the trend toward a smaller size in the evolution of invertebrates with an external skeleton is associated with the mechanical properties of the chitinous skeleton. The disappearance of the basal spines of the claw may be due to the fact that they have no specific functional load.

The morphology of the primitive and ordinary specialized groups of the lower Crustacea thus confirms the existence of a relationship between sexual dimorphism of a character and the phylogenetic tendency of this character. There is an evolutional trend in the family Chydoridae toward a smaller size, and a reduction in the anal denticles and in the basal spines of the claw of the postabdomen. The rule of sexual dimorphism proves that Dunhevedia and Dadaya (Chydorinae) and Leydigia (Aloninae) are phylogenetically recent forms. This conclusion sheds light on the otherwise inexplicable cases of a decrease in the number of basal spines (in contrast to the norm for the group). This interpretation of the morphology of the legs and other organs of Chydoridae justifies a revision of the phylogeny of the family as proposed by Bening (1912:50). According to Bening, Leydigia is a link between the Macrothricidae, Daphniidae, and Sididae on the one hand and the Chydoridae, particularly Biapertura affinis (Alona affinis), on the other hand. Our material, however, suggests that

Leydigia is the most specialized genus. Bening places Acroperus and Alonopsis in opposite parts of his scheme, but new evidence has shown that Alonopsis elongata is related to Acroperus (Smirnov, 1966a). Our scheme of the phylogeny of the genera of Chydoridae is shown in Figure 182. The phylogenetic development of Chydoridae is apparently slow. Frey (1962b) states that Chydoridae are known from the Tertiary and have changed little since.

Chydoridae show the following phylogenetic trends: decrease in size;
161 proximal displacement of the anus; oligomerization of the number of setae on the legs, especially on the exopodites; suppression of the anal denticles by the lateral setae; specialization of legs; displacement of setae from the lower margin of the valves to the inner side (closer to the pump chamber, independently in the Chydorinae and Aloninae with a convex lower margin of the valve).

Later evolutional trends in the subfamily Chydorinae are toward forms adapted to live in different conditions on a substrate in the aquatic environment (including substrates such as floating masses of algae in the pelagial). The subfamily Aloninae shows a further adaptation for life in the bottom. The forms which developed from this trend of evolution will probably have a markedly reduced leg III and an enlarged ocellus. The outer ramus of the endite of leg I of these forms is characterized by three setae of different length.

METHODS OF RESEARCH

Collection of specimens is best done with a net of dense silk gauze. Quantitative sampling can be done with a bottom grab, a quantitative scraper, or by filtration of a bucket of water through a plankton net. Benthic species are collected with a tubular bottom grab, and at greater depth with a stratometer. Since Chydoridae either swim or rest on substrates and on the bottom, we usually took samples simultaneously with a plant grab and a bottom grab; we expressed the results in mg per combined meter (i. e., 1 m^2 of bottom + 1 m^3 of water above it). We took samples from various types of vegetation and different types of bare bottom. The material was fixed in 4% formalin. The best fixative for histology is Zenker's fluid (Fryer, 1963b). The material is examined under the binocular microscope with an eyepiece micrometer and a microscope with an eyepiece micrometer. Permanent preparations are mounted in Canada balsam. Frey (1959), Megard (1965) and others use polyvinyl-lactophenol. Preparations of Chydoridae fixed in formalin can be kept for years in glycerol. Examination of live specimens provides valuable data on the behavior and action of different organs. The integument of Chydoridae can be divided into its components by heating for several minutes in concentrated hydrochloric acid; for permanent preparations, the parts are removed from the acid with a tungsten wire loop on which no gas bubbles are formed (Megard, 1965).

Chydoridae can be cultured on successive batches of detritus. The cultures give information on the age characteristics of Chydoridae, since the exuviae show the characters of all stages. The cultures also permit study of the life cycle, nutrition, behavior, and the influence of environmental factors. Pseudochydorus globosus died after being kept in dishes whose bottom was completely covered with detritus, but it grew well if there were pieces of overgrown macrophytes. Good results are obtained in jars containing filamentous algae and pieces of macrophytes which have been previously washed. In such cultures, the animals reach a considerable density and males appear. Pleuroxus aduncus, P. trigonellus, P. striatus, P. truncatus, Chydorus sphaericus, Acroperus harpae, and Eurycercus lamellatus have been cultured under these conditions. Sars (1886, 1901) and Harding (1955) have grown Chydoridae from silt containing ephippia sent from abroad. Sars (1886) placed this silt in an aquarium containing filamentous algae and gasteropod mollusks. The water did not deteriorate and the algae did not grow excessively, but the crustaceans became mature and reproduced for a long time.

Fryer (1963b) used the Mallory stain for histological preparations. Vital staining of the epipodites was carried out in a pink solution of potassium permanganate or a solution of silver nitrate (these substances become reduced in areas where the internal fluids are oxidized). The same solutions stain the cavities and canals of the head pores. Treatment with 500 ‰* methylene blue for 15 minutes stains mainly the epipodites of legs IV and V and the antennules (Acroperus harpae). A 10% solution of bromcresol purple stains the cavities of the head pores. The eye pigment is dissolved in the following solution: 3 parts 10% NaOH, 3 parts pyridine, 10 parts 30% glucose. Alkali alone also dissolves the eye pigment, but less effectively. The ommatidia can be counted after the pigment has been dissolved.

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* [Obviously a misprint. The usual concentrations for vital staining with Methylene blue are 0.2–0.5‰, and weaker concentrations are used for invertebrates. The author probably meant 5‰ or even 0.5‰.]

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Key to the Families of the Order Cladocera

1 (14). Valves covering legs and body.
2 (5). Six pairs of legs of similar structure.
3 (4). Length far greater than the height. Head well defined . . . . 1. **Sididae** Baird, 1850.
4 (3). Length not exceeding the height. Head not well defined . . . . 2. **Holopedidae** Sars, 1865.
5 (2). Five or six pairs of legs of different structure.
6 (13). Antennules not fused with rostrum.
7 (12). One ramus of antennae 3-segmented, the other 4-segmented.
8 (9). Antennules short, immobile . . . . 3. **Daphniidae** Straus, 1820.
9 (8). Antennules long, mobile.
10 (11). Antennules situated on ventral side of head . . . . 4. **Moinidae** Goulden, 1967.
11 (10). Antennules situated on anterior margin of head . . . . 5. **Macrothricidae** Baird, 1843.
12 (7). Both rami of antennae 3-segmented . . . . 6. **Chydoridae** Stebbing, 1902.
13 (6). Antennules fused with rostrum, forming a snoutlike formation . . . . 7. **Bosminidae** Sars, 1865.
14 (1). Body and legs not covered with valves.
15 (20). Head short.
16 (17). Caudal appendage very short . . . . 8. **Podonidae** Mordukhai-Boltovskoi, 1968.
17 (16). Caudal appendage well developed.
18 (19). Caudal appendage slightly shorter than body . . . . 9. **Polyphemidae** Baird, 1845.
19 (18). Caudal appendage slightly longer than body . . . . 10. **Cercopagidae** Mordukhai-Boltovskoi, 1968.
20 (15). Head oblong . . . . 11. **Leptodoridae** Lilljeborg, 1861.

LIST OF ABBREVIATIONS USED IN THE FIGURES OF THIS SYSTEMATIC PART

AI – antennule;
AII – antenna;
AB – abdominal part;

C – claw;
CL – posteroventral corner of left valve;
CR – posteroventral corner of right valve;
CV – posteroventral corner of valve;
E – ephippium;
GN – gnathobase;
H – head;
HP – head pores;
HS – head shield;
L – labrum;
M – maxillule;
MD – mandible;
P – postabdomen;
R – rostrum;
V – valve;
I, II, III, IV, V, VI – pairs I–VI of thoracic limbs.

197 Family CHYDORIDAE Stebbing, 1902

Baird, 1850:115 (Lynceidae); Schoedler, 1862:5–6 (Lynceidae); 1863:5–6 (Lynceidae); P. E. Müller, 1867:92, 156–161 (subfam. Lynceinae); Hellich, 1874:218 (subfam. Lynceinae); 1877:72 (Lynceidae); Kurz, 1875:35–36; Herrick, 1884:77–80 (Lynceidae); Daday, 1888:84 (Lynceidae); Sars, 1891:12 (Lynceidae); Dybowski and Grochowski, 1895:149–154 (Eurycercidae + Lynceidae); Stingelin, 1895:237 (Lynceidae); Lilljeborg, 1900:381 (Lynceidae); Stebbing, 1902:101–106; Sars, 1903a:25; 1903b:13; Daday, 1910b:120; Bergamin, 1939:89; Bening, 1941:240; Šrámek-Hušek et al., 1962:310–311; Herbst, 1962:76; Manuilova, 1964:207; Frey, 1967a:34.

Type genus: Chydorus Leach, 1816.

Body oval (in lateral view), sometimes almost rounded. Valves covering abdomen and postabdomen. Head shield with head pores (with rare exceptions). Antennae short, rami 3-segmented. Endopodite of antennae with 3 setae, exopodite with 3–5 setae. Antennules one-segmented, mobile. Labrum with a plate which differs in the different species. Intestine forming loops. Postabdomen of female with anal denticles. Postabdomen with terminal claws. Ocellus present. Five to 6 pairs of legs. Legs markedly different. Leg I with small exopodite with 1–2 setae and with tripartite endite; outer ramus of endite with strongly chitinized setae, serving for movement on the substrate. Leg II with small exopodite with 1–2 setae; endite with 8 thick setae, without sensory papillae. Gnathobase of leg II with a row of feathered setae. Legs III–V with large exopodites with 4–9 setae, and with small endite and gnathobase. Endite and gnathobase of these legs with rows of feathered setae. These setae, together with the row of feathered setae of the gnathobase of leg II, form a chamber for the filtration of food. Legs III, IV, and V with large exopodites. Leg VI in form of a small lobe or absent.

Males smaller than females, with larger antennules, a modified postabdomen, and a hook on the first pair of legs. Anal denticles and lateral setae of postabdomen of male reduced compared with the female.

(198-199)

TABLE 29. Number of setae on the legs (– no data)

Subfamily and species	Antenna	Leg I				Leg II				Leg III				Leg IV				Leg V		
		exopodite	outer ramus of endite of female (male)	anterior lobe of inner ramus of endite	posterior lobe of inner ramus of endite	exopodite	hard setae of endite	soft setae of endite	filtering fan of gnathobase	exopodite	hard setae of endite	soft setae of endite	filtering fan of gnathobase	exopodite	hard setae of endite	soft setae of endite	filtering fan of gnathobase	exopodite	hard setae of endite	filtering fan of gnathobase
Eurycercinae																				
Eurycercus glacialis ...	8	2	3	4	4	1	8	8	8	8	7	8	10	9–10	4	5	11	8	2	9–10
E. lamellatus	8	2	3(3)	4	4	–	8	8	8	8	7	8	9	8	4–5	5	9	7	2	8
E. polyodontus (after Dybowski and Grochowski, 1898b)	8	2	3	–	–	–	8	–	8	8	–	–	9	8	–	–	–	7	2	8
Sayciinae																				
Saycia cooki	8	–	3	4	4	2	8	0	10–11	8	8	7	13	8	4	4–5	10	6	2	8–10
Chydorinae																				
Pleuroxus aduncus	8	2	3	4	3	1	8	0	–	7	–	6	8	7	–	–	7	4	2	–
P. trigonellus	8	2	3(4)	–	–	1	8	0	–	7	–	–	–	7	4	4	–	4	2	3
P. similis	–	–	3	–	–	1	8	0	–	7	–	–	–	7	–	–	–	4	2	–
P. laevis	8	–	–	–	–	1	8	0	7	7	–	–	8	7	–	–	–	4	–	–
P. striatus	8	2	3	–	–	1	8	0	7	7	–	5	8	7	–	–	–	4	–	–
P. uncinatus	8	2	3	–	–	1	8	0	–	7	–	5	7	7	–	–	–	4	2	–
P. truncatus truncatus..	8	2	3(4)	–	–	–	8	0	–	7	8	6	8	7	4	4	5	4	2	3
P. letourneuxi	8	2	3	–	–	–	8	0	–	7	–	–	–	7	–	–	–	4	2	–
Disparalona rostrata rostrata	7	1	3(3)	4	3	–	8	0	7	7	8	7	8	7	4	4	4	4	2	3
Alonella excisa excisa	7	1	3	4	3	1	8	0	7	7	–	–	–	7	–	–	6	4	2	3
A. exigua exigua	7	1	3(3)	–	–	1	8	0	–	7	–	–	–	7	–	–	6	4	2	–
A. nana	7	–	–	–	–	–	8	0	–	7	–	–	–	7	–	–	–	4	–	–
Chydorus sphaericus ...	7	2	3(4)	–	–	1	8	0	8	7	8	7	8	7	–	–	–	4	2	3

Ch.ovalis (after Lilljeborg, 1900)	8	–	3	4	–	1	8	0	8	–	–	–	8	7	–	–	7	4	2	3
Ch. gibbus		1	3(4)	–	–	1	8	0	–	7	–	–	–	7	–	–	–	4	2	3
Ch. eurynotus eurynotus	7	1	3	–	–	–	8	0	–	7	–	–	–	7	–	–	–	4	2	–
Ch. barroisi barroisi	7	1	3	–	–	1	8	0	–	7	–	–	–	7	–	–	–	4	–	–
Ch. brevidentatus	7	1	3	–	–	1	8	0	–	7	–	–	–	7	–	–	–	4	2	4
Ch. bicornutus (after Doolittle, 1911)	7	–	–	–	–	1	8	0	8	7	–	–	9	7	4	4	5	4	2	4
Pseudochydorus globosus globosus	7	1	3(4)	–	–	1	8	0	5	7	7	3	5	7	3	4	5	4	2	3
Dunhevedia crassa	7	–	3	4	3	1	8	0	–	7	8	6	8	7	4	4	–	4	2	4
D.serrata	–	–	–	–	–	1	8	0	7	7	8	6	8	7	4	4	5	4	–	–
Anchistropus emarginatus (after Lilljeborg, 1900)	–	–	–	–	–	1	8	0	5	7	–	–	6	7	–	–	4	4	–	–
Dadaya macrops	7	1	3	–	–	1	8	0	7	7	–	–	–	7	–	–	6	4	2	–
Aloninae																				
Alona quadrangularis	8	1	3	4	3	1	8	0	5	7	8	4	7	6	4	4	5	4	2	–
A.rectangula	8	1	3(3)	–	–	1	8	0	–	6	–	–	6	6	–	–	–	4	2	–
A.costata	8	–	3	–	–	1	8	0	–	7	–	–	–	6	–	–	–	4	2	–
A.davidi	7	1	–	–	–	1	8	0	6	7	–	–	–	6	–	–	6	4	2	–
A.cambouei	7	1	3	–	–	1	8	0	–	7	–	–	–	6	–	–	–	4	2	–
A.rustica	7	1	3	–	–	1	8	0	7	7	8	–	–	6	–	–	–	4	2	–
A.labrosa	–	–	3	–	–	1	8	0	–	–	–	5	4	–	4	–	–	4	2	–
Acroperus harpae	7	1	3	–	–	1	8	0	7	7	–	–	–	6	–	–	7	4	2	–
A.alonoides	7	1	3(3)	–	–	–	8	0	–	6	–	–	–	6	–	–	–	4	2	–

TABLE 29 (continued)

Subfamily and species	Antenna	Leg I				Leg II				Leg III				Leg IV			Leg V			
		exopodite	outer ramus of endite of female (male)	anterior lobe of inner ramus of endite	posterior lobe of inner ramus of endite	exopodite	hard setae of endite	soft setae of endite	filtering fan of gnathobase	exopodite	hard setae of endite	soft setae of endite	filtering fan of gnathobase	exopodite	hard setae of endite	soft setae of endite	filtering fan of gnathobase	exopodite	hard setae of endite	filtering fan of gnathobase
Acroperus elongatus	8	–	3(3)	–	–	–	8	0	–	7	–	–	–	6	–	–	5	4	2	–
Camptocercus rectirostris	7	1	3	4	4	1	8	0	7	7	7	4	7	6	4	–	5	4	2	–
C. lilljeborgi	7	1	3	–	–	–	8	0	6	7	–	–	–	6	–	–	5	4	2	–
C. australis	–	1	3	4	–	1	8	0	–	7	–	–	–	6	–	–	–	4	2	–
Graptoleberis testudinaria	7	1	3(3)	–	–	–	8	0	–	–	–	–	–	6	4	–	–	4	–	–
Kozhowia baicalensis	6	1	3	4	3	1	8	0	–	–	–	4	–	6	–	–	–	4	–	–
K. gajewskajae	–	1	3	4	3	1	8	0	–	7	8	4	7	–	4	–	–	4	2	–
Kurzia latissima	8	1	3	4	3	–	8	0	–	7	–	–	–	6	–	–	–	4	–	–
K. longirostris	8	1	3	4	–	–	8	0	7	6	–	–	–	6	–	–	5	4	2	–
Leydigia leydigi	8	1	3(3)	4	3	1	8	0	–	5	–	4	–	6	–	–	–	4	2	–
L. ciliata	8	1	3	–	–	1	8	0	6	–	–	–	–	6	–	–	–	4	2	–
L. australis (after Sars, 1886)	8	1	3(3)	4	3	–	–	0	8	–	–	4	6	6	–	–	–	4	–	–
Oxyurella tenuicaudis	8	1	3	–	–	–	8	0	–	7	–	–	–	6	–	–	–	4	2	–
O. singalensis	8	–	–	–	–	–	8	0	–	7	–	–	–	6	–	–	–	4	–	–
Biapertura affinis	8	1	3(3)	–	–	1	8	0	–	7	–	–	6	6	–	–	–	4	2	3
B. rigidcaudis	7	1	–	–	–	–	8	0	–	7	–	–	–	6	–	–	–	4	–	–
B. karua	7	1	–	–	–	–	8	0	–	–	–	4	6	6	–	–	–	4	–	–
B. kendallensis	–	1	3	4	3	1	8	0	7	7–8	–	4	6	6	4	3	5	4	–	–
Tretocephala ambigua	8	1	3(3)	4	–	–	8	0	8	7	8	4	6	6	–	–	–	4	2	–
Rhynchotalona falcata	7	–	–	–	–	1	8	0	–	7	–	–	–	6	–	–	–	4	–	–
Leydigiopsis curvirostris (after Sars, 1901)	–	–	–	–	–	–	8	0	7	7	–	–	–	6	–	–	–	4	2	–
Euryalona orientalis	–	1	3	–	–	–	8	0	7	7	–	–	–	6	–	–	–	4	2	–
Indialona globulosa	–	1	3	–	–	–	8	0	–	7	–	–	–	6	–	–	–	4	2	–
Monospilus dispar	7	1	–	–	–	1	8	0	–	7	–	–	–	6	–	–	–	4	2	–

Chydoridae are classified according to characters which are valid for the whole family. The subfamilies are distinguished by the morphology of the head pores and legs, the articulation of the mandibles, the number of eye facets, the presence or absence of hepatic processes in the anterior part of the mid-intestine, and the number of young per batch.

The number of basal spines on the claw is also used.

Frey (1967a) recognizes four subfamilies on the basis of these characters. We made some corrections in the diagnosis of the genera, and transferred the species of Alonopsis to the genus Acroperus and united the genera Peracantha and Cornuella with Pleuroxus.

Dybowski and Grochowski (1895) proposed the separation of Eurycercus as an independent family, Eurycercidae.

The classification of Cladocera has been based mainly on the morphology of the legs, but these have been little studied in the Chydoridae.

The characters of the valves, postabdomen, antennules, antennae, and other characters have been used for the establishment of genera. However, these characters do not reflect the phylogenetic relations of the family. Some resemblances of the form of the valves or postabdomen were caused by convergence, and numerous species were transferred from one genus to another after detailed study.

Most descriptions of Chydoridae (except for 17 species) contained no information as to the structure of the legs. However, the legs can contribute much to the definition of the different species. As early as 1866, King stressed the importance of the morphology of the appendages of the body for a diagnosis of the genera of Chydoridae. Our study of the legs has shown that despite the uniform pattern which is characteristic of the family, there are marked differences between the species, especially between species of different genera.

Table 29 gives data on the morphology of the legs of different species of the genera of Chydoridae. Data were taken from the literature for those species for which we had no material.

Legs I and II differ little in the species examined. Legs III, IV, and V differ to some extent in form, but more markedly in the number of setae on the exopodites. Legs VI form small pubescent lobes and are often absent. Leg VI has an epipodite only in the genus Eurycercus.

We made some corrections to the illustrations of the legs of a number of species, published by earlier authors. In the drawings of Lilljeborg (1900), for example, we determined the number of posterior setae on the exopodite of leg III of Disparalona rostrata, Pleuroxus truncatus, and Camptocercus rectirostris. We found that the exopopodite 201 of leg IV Disparalona rostrata and Pleuroxus truncatus bears two distinct pubescent processes above the anterior seta; the pubescence of legs IV and V of Disparalona truncata and Pleuroxus truncatus was found to be more distinct.

We described the structure of the legs of the type species of the genera Chydorus sphaericus, Dunhevedia crassa, Pleuroxus laevis, Alonella excisa, Alona quadrangularis, Oxyurella tenuicaudis, Rhynchotalona falcata, and Monospilus dispar for the first time.

Only leg I of the male differs from that of the female, viz., in the presence of a hook.

Table 29 shows that the number of setae on the exopodites of legs III, IV, and V varies in the different genera. This is one of the main characters for the division into four subfamilies. The exopodites of legs III, IV, and V bear the following number of setae in the different subfamilies: Eury cercinae 8–8(9–10)–7(8); Sayciinae 8–8–6; Chydorinae 7–7–4; Aloninae 7(5)–6–4. These groups differ sharply in the number of setae on the exopodite of leg IV.

Other characters also prove that these are natural groups. Thus, the claws of the postabdomen of females of the subfamilies Eurycercinae and Chydorinae bear two basal spines (however there are specialized forms with a single basal spine in the Chydorinae, viz., Dunhevedia and some species of Chydorus and Alonella). In the Aloninae, the basal spine is single or absent. The Eurycercinae and Sayciinae are also distinguished by their size, which is the largest in the family (1.7–6 mm), and also by the fact that they develop numerous eggs each time (only 2 eggs in the other subfamilies).

In addition to the difference in the number of setae (Table 29), the genera are distinguished by some characters of the structure and form of the legs. In Eurycercus, the posterior margin of the endite of leg II bears a row of thin setae in addition to the main row of thick setae; leg VI of this genus also has an epipodite (these characters are absent in Saycia).

The exopodite of leg III of Chydorus, Pleuroxus, and Alonella bears 3 setae on the posterior margin; the ventral margin of this exopodite bears 4 setae, the longest not more than double the length of the shortest. Anchistropus is distinguished by a hook on leg I of the female. The exopodite of leg III of Alona and Oxyurella bears 2 setae on the posterior margin and 5 setae on the ventral margin; the posterior one of these setae is very large and long. One seta on legs I and II of Leydigia is very long. The exopodite of leg V of Acroperus is slightly bilobed. Camptocercus differs from the other genera in that leg IV resembles leg III more than leg V. Leg I of Euryalona bears a hook-shaped seta.

The descriptions of new species should include a description of all legs, the head pores, the basal spines of the claws, and the number of eggs in the brood chamber because of the great diagnostic importance of these characters.

Kurz (1875) defined the genera according to the form of the body, the structure of the head shield, the postabdomen, the antennae, the antennules, the posteroventral corner of the valve, the position of the opening of the vas deferens, and some other characters.

The genera are distinguished at present according to the form of the body, the structure of the postabdomen, the antennae, and the relative size of ocellus and eye. The species differ in details of the form of the body and postabdomen and in the spatial relationships between the cephalic appendages, the eye, and the ocellus.

Differences between the chitinized walking setae on the outer ramus of the endite of leg I are specific characters. An example of the diagnostic importance of this character is given in the drawings (Figure 115) of the outer ramus of the endite and exopodite of species which are otherwise almost indistinguishable, viz., Alona quadrangularis and Biapertura affinis. This character should therefore be included in the diagnosis of genera.

The subspecies are distinguished by differences in the form and armature of the postabdomen, the length of the antennules in relation to the apex of the rostrum, etc. A subspecific character is the sculpture of the valve. However, specimens with pitted valves occur in many species together with others with smooth valves; this suggests that the pitted condition may appear temporarily under the influence of unknown factors. We will consider them as subspecies until the mechanism of the pitted condition has been determined.

To help determine fragments from food masses and bottom sediments we give keys to the subfamilies and genera according to the head shield.

Key to the Subfamilies of the Family Chydoridae

1 (4). Exopodites of legs III–IV with 8–10 setae. Eggs numerous.
2 (3). Exopodite of leg V with 7 or 8 setae. Leg VI present, with an exopodite. Body oval. Postabdomen wide, serrated (more than 80 denticles). Head pores present . . . . I. **Eurycercinae** Kurz, 1875 (p. 202).
202 3 (2). Exopodite of leg V with 6 setae. Five pairs of legs. Body rounded. Postabdomen short. Head pore indistinct . . . . II. **Sayciinae** Frey, 1967 (p. 212).
4 (1). Exopodites of legs III and IV with at most 7 setae. Eggs at most 2 (rarely 3).
5 (6). Exopodites of legs III and IV with 7 setae. Head pores in median line of head shield, main pores separated or isolated, small pores situated between the main pores . . . . III. **Chydorinae** Stebbing, 1902 (p. 215).
6 (5). Exopodite of leg IV with 6 setae. Main head pores situated in median line of head shield, fused, separate or isolated; small pores situated lateral to median line . . . . IV. **Aloninae** Frey, 1967 (p. 336).

Key to the Subfamilies of Chydoridae according to Head Shields

1 (6). Head shield with head pores.
2 (3). Main pore single, situated near posterior margin of head shield; small pores adjacent lateral to main pore . . . . . . I. Eurycercinae.
3 (2). Two or 3 main pores; if there is only a single main pore then small pores are absent.
4 (5). Two main pores, separate, situated in median line of head shield; 2 small pores situated between main pores; if there is a single main pore then it is situated far from posterior margin of head shield . . . . III. Chydorinae.
5 (4). Two or 3 main pores, united, situated in median line of head shield; small pores situated lateral to main pores; there are sometimes 2 separate main pores in the median line of the head shield with 2 small pores between them and a small pore on each side; if the

main pore is single, it is situated near posterior margin of head shield . . . . IV. Aloninae.

6 (1). Head shield without head pores . . . . II. Sayciinae.

I. Subfamily EURYCERCINAE Kurz, 1875

P. E. Müller, 1867:92, 161 (series generum Eurycercus); Kurz, 1875 1875:30; Dybowski and Grochowski, 1895:149 (Eurycercidae); Bening, 1941:241.

Type genus: Eurycercus Baird, 1843.

Outline of body oval. Ratio of height to width 1.3–1.5. Main head pore large, rounded, situated near posterior margin of head shield; small lateral pores adjacent to main pore (Figure 5). Canals extending from lateral pores. Mandibles articulated between head shield and valve. Numerous subitaneous and latent eggs. Claws with 2 basal spines.

Six pairs of legs; leg VI with epipodite. Leg I with exopodite with a long and a short seta. Outer lobe of endite with 3 setae of different length. Anterior part of inner lobe of endite with 4 setae, posterior part with 8 setae. Leg II with endite with 8 hard setae and a parallel row of 8 soft setae (setae F and G relatively large and hard). Gnathobase with filtering fan of 8 setae. Exopodite small, with a small seta. Leg III with large square exopodite with 3 setae on dorsal side and 6 setae on posterior side. The dorsal seta near the epipodite is the largest; the middle seta of the posterior setae is short and the others of about equal length. Endite of leg III with hard setae, 8 soft setae, and with a sensilla on the side of the gnathobase. Gnathobase of leg III with filtering fan of 9 or 10 setae. Apex of gnathobase with 3 specialized setae. Leg IV with large exopodite with 8 or 9 setae. Endite of leg IV with 4 hard setae and a sensilla on the side of the gnathobase. Endite with 5 soft setae. Gnathobase of leg IV with filtering fan of 9–11 setae. Leg V with very large exopodite with 3 setae on the posterior side and 4 or 5 setae on the anterior side. Endite of leg V with a lobe and 2 setae, and a sensilla and seta 1 of the gnathobase proximal to them; the latter seta closely resembles the former two setae and is curved in the same direction. Gnathobase with filtering fan of up to 10 setae. Legs IV and V with a differentiated preepipodite in the form of a pubescent lobe. Intestine with two hepatic processes. A short caecum present.

Postabdomen wide, with more than 80 preanal denticles. Anus situated on distal end of postabdomen. Length 0.7 to 6 mm, i. e., much larger than the other Chydoridae. One genus with 3 species.

The above characters show that the Eurycercinae are the most primitive subfamily of Chydoridae.

203 1. Genus Eurycercus Baird, 1843

O. F. Müller, 1785 (Lynceus, partim); Baird, 1843:88; Schoedler, 1862: 6–9; Lilljeborg, 1900:384–385; Bening, 1941:241; Šrámek-Hušek et al., 1962:311–312; Herbst, 1962:78.

Type species: Eurycercus lamellatus (O. F. Müller, 1785).

This genus was described by Baird (1843:88) as almost rectangular, with a very wide postabdomen in the form of a broad plate with numerous denticles.

Head shield with rounded anterior and posterior margin. Main head pore single, bordered by small pores. Antennules and antennae with numerous transverse rows of spinules. Postabdomen with numerous preanal denticles (70–150) in a single row. Claws with 2 basal teeth. The spinules are dorsal on the base of the claws. Postabdomen with lateral groups of small spinules.

Intestine forming loops, with a short caecum on ventral side of mid-intestine at the border with the hind intestine; two hepatic processes in anterior part of mid-intestine.

Six pairs of legs as described for the subfamily.

The species of Eurycercus show several characters which are absent in other Chydoridae, viz., processes in the anterior part of the intestine, a well developed row of preanal spinules, the presence of an epipodite on leg VI, and many more setae on the exopodites of legs III–V. The largest numbers of setae on the exopodite, i. e., 9 on the exopodite of leg IV and 8 on the exopodite of leg V, are found in Eurycercus glacialis. Because of these characters and because it is the largest species of Chydoridae, E. lamellatus may be considered as the most primitive species of the genus Eurycercus and of the family as a whole.

The vasa deferentia open in the proximal part of the postabdomen, on the ventral side.

Key to Species of the Genus Eurycercus
according to Females

1 (2). Postabdomen with 83–135 denticles. Antennules with a sensory seta in middle part of anterior side . . . . 1. **E. lamellatus** (O. F. Müller, 1785).
2 (1). Postabdomen either with about 150 denticles or not more than 100; in the latter case, antennules with the sensory seta situated in distal part of anterior side.
3 (4). Postabdomen with not more than 100 denticles. Antennules with the sensory seta in distal part of anterior side. . . . . 2. **E. glacialis** Lilljeborg, 1887.
4 (3). Postabdomen with about 150 denticles . . . . 3. **E. polyodontus** Dybowski and Grochowski, 1894.

Key to Known Males of the Genus Eurycercus

1 (2). Antennules with a sensory seta in proximal quarter of anterior margin and one seta in proximal half . . . . 1. **E. lamellatus** (O. F. Müller, 1785).
2 (1). Antennules with a sensory seta in middle of anterior margin and one seta in distal half . . . . 2. **E. glacialis** Lilljeborg, 1887.

1. **Eurycercus lamellatus** (O. F. Müller, 1785)
(Figures 183–189)

O. F. Müller, 1785:73–74, Plate IX, Figures 4–6 (Lynceus); Linné, 1788:3008 (Monoculus); Baird, 1843:88–89, Plate II, Figures 1–8; Zaddach, 1844:28–29 (Lynceus); Liévin, 1848:39–40, Plate IX (Lynceus); Baird, 1850:124, Plate XV, Figures 1, 1a, b; Fischer, 1851:187–188, Plate VIII, Figures 4–7 (L. laticaudatus); Leydig, 1860:209–215, Plate VII, Figures 52–26, Plate X, Figure 72 (Lynceus); Schoedler, 1862:9; Gerstaecker, 1866–1879:866, Plate XXIV, Figures 1–5; Lilljeborg, 1900:385–393, Plate LIX, Figures 1–10; Birabén, 1939:652–654, Figures 1, 2, 3 (var. minuta); Bening, 1941:241–244, Figure 102; Kaiser, 1959:22–33, Figures 5C, 6B, 7A; Šrámek-Hušek et al., 1962:312–314, Figures 4, 5; Herbst, 1962:78–80, Figure 53; Fryer, 1963b:335–380, Figures 1–56; Chiang Sieh-chih, 1964:78, Figures 10–13; Negrea, 1966a:138–139.

Material. Females in large numbers from the Ivan'kovo, Rybinsk, and Cherepovets reservoirs, the Komi ASSR, the Sredne-Vezhinskii Pond (Perm Region), ponds of the Yakot' fish farm (Moscow region), water bodies in the delta of the Terek, and lakes in the Altai. Several females from each of the following places: lakes in the Aktyubinsk and Dzhambul regions, Lake Sonkul', a tributary of Lake Baikal (near Bol'shie Koty), Frolikh Inlet 208 (northeastern part of Lake Baikal), Amur Basin, and Kamchatka; 2 females from Corrientes, Argentina. Males in large numbers from the Cherepovets and Rybinsk reservoirs. Preparations: MGU – female 77, 75, 84, 88, 2134, deformed females 1076, 62, 1144, 29, ephippial female 917, ephippium 1163, male 907. ZIN – females 75, 2133, ephippial female 916, ephippium 902, male 1164. Ph* – female 905, male 910.

Female. Dorsal margin convex. Ventral margin of valve straight in its greater part. Posterodorsal and posteroventral corner of valves rounded.

Valves with row of setae on ventral margin and a row of small spinules at end of ventral margin and on part of posterior margin. Valve with indistinct pattern of pentagons or hexagons. Dorsal keel present. Head keel absent. Head shield with rounded anterior and posterior margin, and with large, transverse, oval main pore bordered by a small lateral pore on each side. Antennules with spine-shaped incisions. Sensory seta situated in middle of anterior margin of antennule. Distal end of antennule with a crown of spines around the esthetascs; the latter are of equal length. Antennules projecting by less than half their length beyond apex of rostrum. Antennae with two 2-segmented sensory setae in lateral part of base and one spine in distal part of base. Setae of antennae: 0–0–3/1–1–3. One spine on proximal segment of exopodite and on both distal segments. Segments of antennae with rows of small spinules (spine-shaped incisions). Setae of antennae feathered. Plate of labrum triangular. Maxillules with 4 pubescent setae, one of them short. Postabdomen with concave distal margin.

Distal preanal denticle much larger than the others, which gradually decrease in size proximally. Natatorial setae 2-segmented, pubescent. Claws with setae on concave margin and with 2 basal spines, the distal spine being the larger. From 18 to 20 denticles on margin adjacent to claws.

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* [Philadelphia Academy of Natural Sciences.]

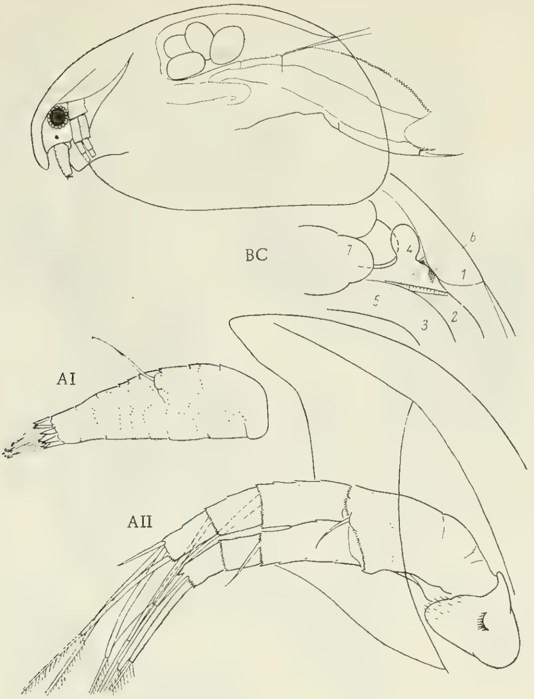

FIGURE 183. Eurycercus lamellatus, female 1.8 mm long (Sunozhka River, 9 August 1962):

BC — posterior margin of brood chamber (Rybinsk Reservoir, Borok, 22 May 1964). 1 — posterodorsal corner; 2 — abdomen; 3 — intestine; 4 — abdominal process; 5 — row of setae; 6 — anterior blue spot; 7 — embryos.

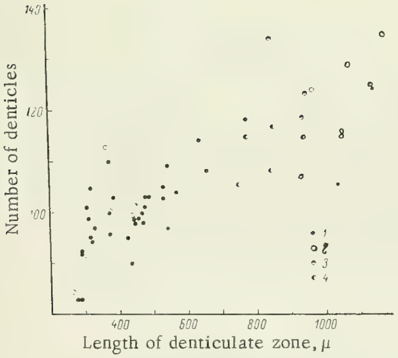

FIGURE 184. Relationship between the number of anal denticles and the length of the denticulate margin of the postabdomen of females of Eurycercus lamellatus:

1 — after Frey, 1958, Central Europe; 2 — Cherepovets Reservoir, mouth of the Kovzha, 20 October 1963; 3 — Sunozhka River, 20 August 1962; 4 — Lake Seito (Vashutkiny Lakes, Arkhangelsk Region), 17 August 1961.

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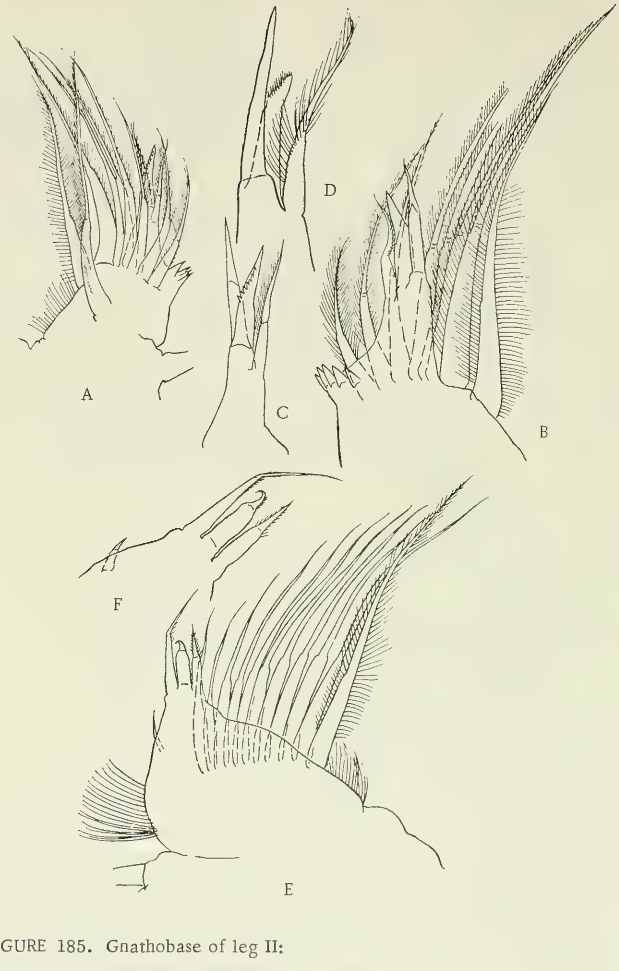

FIGURE 185. Gnathobase of leg II:

A, B, C — Eurycercus lamellatus (left legs, pond of the Yakot' fish farm); D — E. glacialis (right gnathobase, inner view; Holland, Wadden Island, dune lake, 24 August 1965); E, F — Saycia cooki (right gnathobase, outer view; New Zealand, Mangere, May 1965). A — with accessory seta (outer view; 5 July 1967); B — normal structure (inner side of leg; 15 September 1967); C, D, F — apex of gnathobase (C — 5 July 1967).

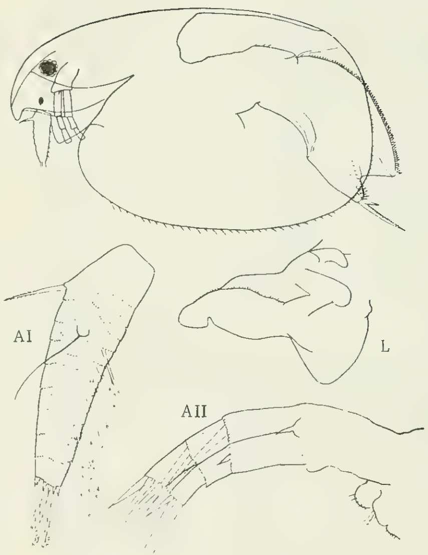

FIGURE 186. Eurycercus lamellatus, length 1.12 mm (Rybinsk Reservoir, 2 October 1962)

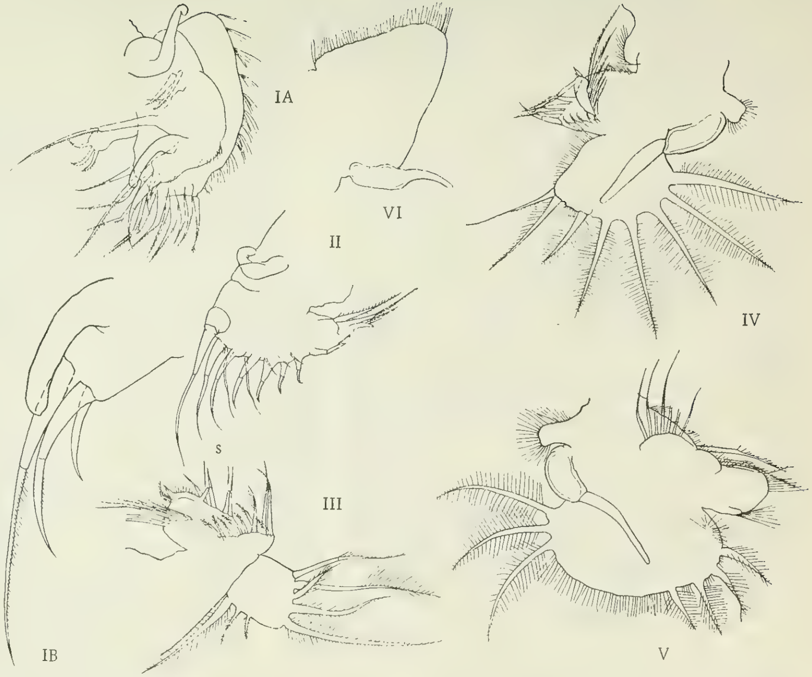

FIGURE 187. Legs of male of Eurycercus lamellatus (Rybinsk Reservoir, Borok, 2 October 1962):

IA, V – right leg, outer view; IB – outer ramus of endite; II – right leg, inner view; III – right leg, outer view; s – sensilla; IV – left leg, outer view; VI – left leg, inner view. Legs I–VI drawn to scale.

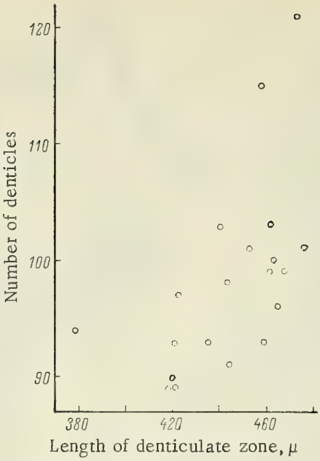

FIGURE 188. Relationship between number of anal denticles and length of denticulate margin of postabdomen of males of Eurycercus lamellatus; length of males 1–1.22 mm (Cherepovets Reservoir, 20 October 1963)

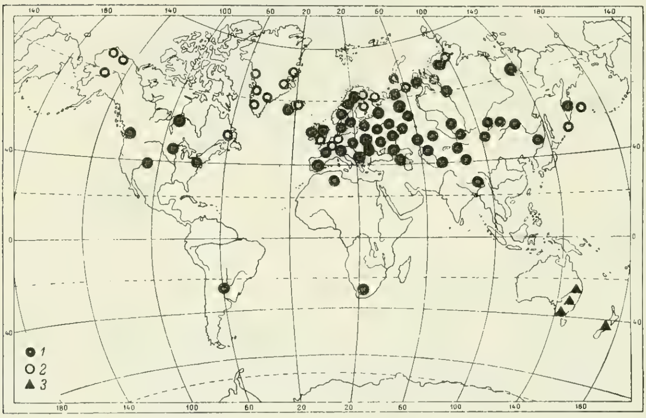

FIGURE 189. Distribution:

1 – Eurycercus lamellatus; 2 – E. glacialis; 3 – Saycia cooki.

Palearctic females more than 0.7 mm long, to 5 mm. Two other females from Argentina were 0.65 mm (preparation 2174) and 0.74 mm (preparation 2133) long. Birabén (1939) gives a length of 0.58–0.65 mm for specimens from Argentina.

The relative size of the head of the female decreases with age. The body becomes higher; the ratio of height to length is 1:1.5 at a length of 1.0 mm, and 1:1.3 in larger specimens. There is a process which closes the brood chamber in the posterior part of the abdomen of mature females.

The number of denticles on the postabdomen increases with age; it is proportional to the length of the denticulate part, and increases from 83 to 135. The length of the denticulate part increases from 300 to 1,170 μ (length of body 2.46 mm; Figure 184). The female of preparation 77 has 108 denticles (length of denticulate part 444μ, length of body 1.8 mm).

The legs were illustrated (but with some inaccuracies) by Baird (1850, Plate XV) and Gerstaecker (1866–1879). A detailed description of the legs of the female was recently published by Fryer (1963b). The filtering fans of the gnathobases of legs III and IV bear 9 setae, while that of leg V bears 8 setae.

The exopodite of leg IV bears 8 setae, while that of leg V bears 7 setae. The epipodites of legs I–VI bear narrow processes.

The intestine forms loops. The caecum is short. Eye with 28 facets. Ocellus small, situated at base of antennule. Ephippium containing several eggs.

Male. Dorsal and ventral margin almost equally convex. Posterodorsal and posteroventral corners of valve rounded. Antennules with spine-shaped incisions. Anterior margin of antennules with two sensory setae situated proximal to the middle. Distal end of antennules with a crown of spinules around the esthetascs. There are also numerous esthetascs on posterior margin of antennule. Antennules projecting by more than half their length beyond apex of rostrum. Base of antennae with 2 two-segmented setae in the proximal part and a distal spine. Spines on antennae: 1–0–1/0–0–1, setae: 0–0–3/1–1–3. Plate of labrum triangular, labrum with pubescent inner side.

Postabdomen resembling that of female. Vas deferens opening ventrally in proximal part of postabdomen. From 89 to 121 postabdominal denticles, their number usually proportional to the length of the denticulate part. The legs of the males examined resemble those of the female, but the base of the outer ramus of the endite of leg I bears a hook. Antennules, eye, and ocellus relatively larger than in the female. Length to 1.3 mm.

Distribution. Holarctic Region. Also Argentina and South Africa. Ubiquitous in the USSR.

Biology. Lives in the vegetation. Monocyclic at vegetation periods of less than 7 months, dicyclic at longer vegetation periods (Vereshchagin, 1912c).

2. **Eurycercus glacialis** Lilljeborg, 1887 (Figures 190–193)

Kröyer, 1838:92 (Lynceus lamellatus); Lilljeborg, 1887:154; Wesenberg-Lund, 1895:123, Plate IV, Figure 20 (lamellatus); Lilljeborg,

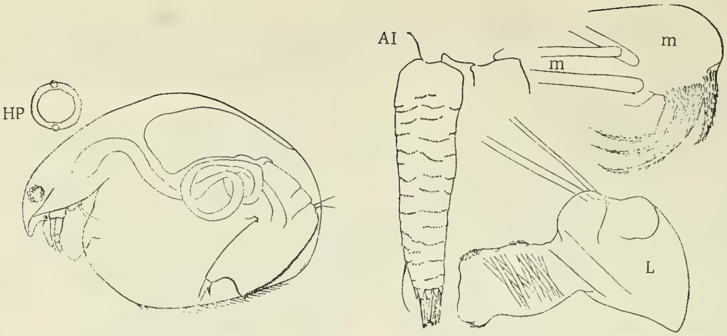

FIGURE 190. Eurycercus glacialis, female, 2.8 mm long (Holland, Wadden Island, dune lake, V.Hunenplak, 24 August 1965):

AI – right antennule, dorsal view; m – muscles.

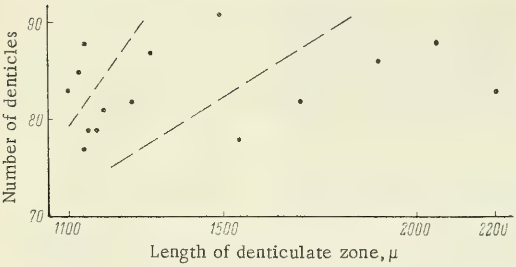

FIGURE 191. Variation in number of denticles on postabdomen of females of Eurycercus glacialis (Holland, Wadden Island, dune lake, August 1965). The sloping lines separate assumed stages.

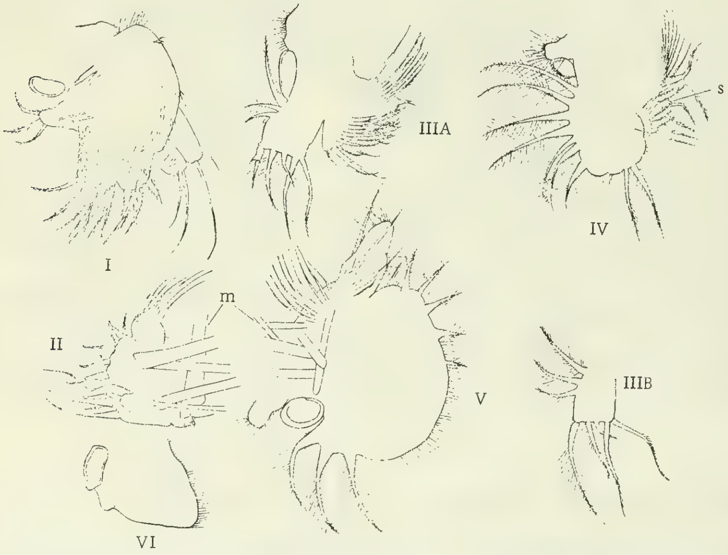

FIGURE 192. Leg of female of Eurycercus glacialis (Holland, Wadden Island, dune lake, V.Hunenplak, 24 August 1965):

I, II, IV – left legs, inner view; III – left leg, outer view, one seta on the exopodite abnormally short; IIIB – exopodite with normal setae; V, VI – right legs, outer view; s – sensilla; m – muscles.

210 1900:393–398, Plate LX, Figure 11, Plate LXI, Figures 1–13; Frey, 1958: Plate 36, Figure 20; Kaiser, 1959:17–33, Figures 5a, b, 6A, 7B, C, 8, 9; Herbst, 1962:80, Figure 54.

Material. 22 females from Holland. Preparations MGU – female 328. ZIN – female 123.

Female. Outline of head and dorsum forming together a smooth curve independent of age. Ratio of height to length 3:2. Posterodorsal and posteroventral corners of valve rounded. Valves with reticulate pattern of irregular pentagonal-hexagonal cells. Head shield with rounded pore; lateral pores adjacent to main pore and situated before its diameter (Frey, 1958). Antennules projecting beyond apex of rostrum by less than half their length; sensory seta situated between middle and end of antennule. Distal margin of postabdomen curved. Postabdomen with 77-91 denticles, proximal denticles slightly smaller than distal ones.

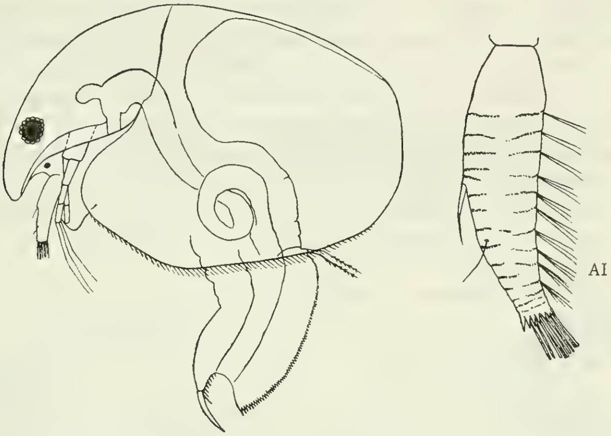

FIGURE 193. Eurycercus glacialis, male (after Lilljeborg, 1900)

The number of denticles is not proportional to the length of the denticulate margin. The groups of points shown in Figure 191 indicate some variation in the number of denticles in each stage; this variation is similar in the different stages. Claws with 2 basal spines, distal spine larger.

Maxillules with 4 pubescent setae, 3 of them long, two-segmented, the other short.

Filtering fan of gnathobase of leg II with 8 setae, leg III 10 setae, leg IV 11 setae. Exopodite of leg IV with 9 setae, leg V 8 setae.

Epipodites without long processes. Intestine forming a loop with 2 turns. About 40 subitaneous eggs. Length 4.8 mm in our material, to 6 mm according to the literature.

Male. Dorsal margin of head and valves forming together a smooth curve. Posterodorsal and posteroventral corner of valves rounded. Valves with reticulate pattern of irregular pentagons and hexagons. Antennules projecting by one half of their length beyond apex of rostrum. Segmented sensory seta of antennules situated in middle of anterior side, sensory seta situated distal to middle. Esthetascs situated on distal end; numerous esthetascs on posterior margin. Antennules, eye, and ocellus relatively much larger than in female. Length to 2 mm.

Distribution. Arctic Subregion, the subarctic areas of the USSR and islands near Kamchatka (Figure 189).

3. Eurycercus polyodontus Dybowski and Grochowski, 1894 (Figures 194, 195)

Dybowski and Grochowski, 1894:380; 1895:149; 1898a:296–314, Figures 6–15; 1898b:434–444, Figures 17–30.

Material. Types in the Zoological Museum of Lvov State University. 212 The largest specimen has a postabdomen with 147 denticles and may be considered as the lectotype. The postabdomen of the other specimens has 120–125 denticles, which shows that they belong to E. lamellatus.

Female. Characters as in E. lamellatus. As shown in Figure 184, specimens of E. lamellatus from other localities and of a similar length have a maximum of 135 anal denticles (although the points are highly scattered, the highest points do not attain the values which Dybowski and Grochowski consider as characteristic of E. polyodontus). Setae on antennae: 0–0–3/1–1–3, spinules: 1–0–1/0–0–1. Exopodite of leg IV with 8 setae, leg V with 7 setae.

Male. Unknown.

Distribution. Western Ukraine.

Species incertae sedis

Eurycercus cunninghami King, 1853:247, Plate VII, A (E. cunninghami); Sars, 1888:69 (Kingia cunninghami).

Sars states correctly that it does not belong to Eurycercus and that this form may be considered as the type of a new genus, Kingia. The description and figures given by King are so inaccurate that this form cannot be placed in any of the genera described, nor can it be considered as a separate genus.

Eurycercus polyodontus var. goplanus Dybowski and Grochowski, 1895:149. Nomen nudum.

Eurycercus spinosus King, 1853:257, Plate VII, D; Sars, 1888:69 (Kingia spinosa).

Sars states correctly that this form differs distinctly from Eurycercus. We place this species together with E. cunninghami in the present section because they cannot be placed in any of the other genera.

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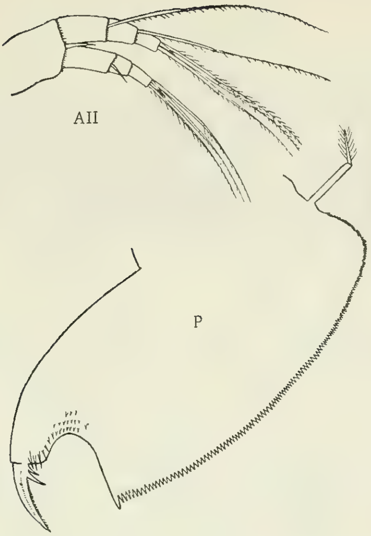

FIGURE 194. Eurycercus polyodontus, female (after Dybowski and Grochowski, 1898b)

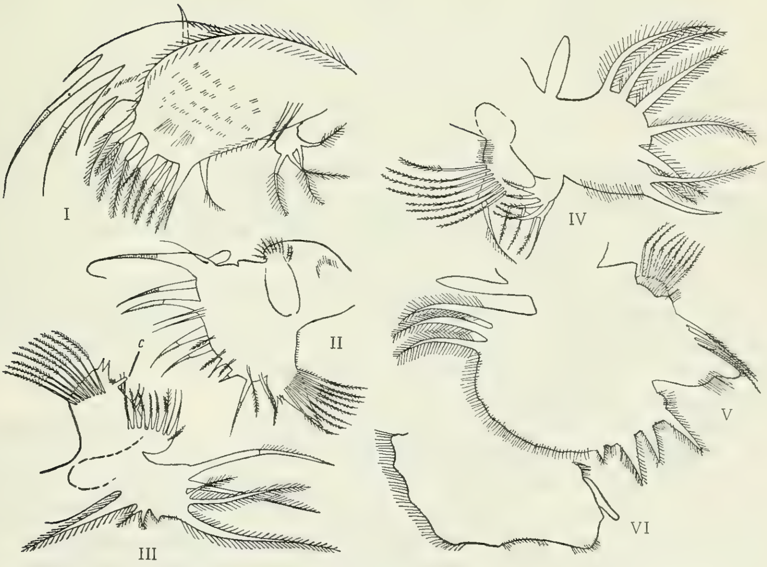

FIGURE 195. Legs of female of Eurycercus polyodontus (after Dybowski and Grochowski, 1898b)

II. Subfamily SAYCIINAE Frey, 1967

Frey, 1967a:35.

Type genus: Saycia Sars, 1904.
Outline of body rounded. Head pores indistinguishable. Mandibles articulated between head shield and valve. Intestine without hepatic processes. Postabdomen short. Anus situated in middle of dorsal margin of postabdomen. For morphology of the legs see description of Saycia cooki. Numerous subitaneous and latent eggs.

2. Genus Saycia Sars, 1904

Sars, 1904a:4–5.

Type species: Saycia cooki (King, 1866).
Body of female rounded in lateral view. Body laterally compressed, much higher than wide. Head not divided by a depression from other part of carapace. Posteroventral margin of valve without denticles. Rostrum pointed. Antennules conical. Endopodite of antennae with 3 setae, exopodite with 5 setae. All these setae are well developed, two-segmented, and feathered. Postabdomen tapering. Claws short.

Anal denticles small, irregularly distributed. Postabdomen with dorsal and lateral groups of setae. Morphology of legs as described for Saycia cooki. Eye slightly larger than ocellus.

1. Saycia cooki (King, 1866) (Figures 196–199)

King, 1866:165–166, Plate XIII (Eurycercus); Sars, 1904a:3–15, Figures 1–15 (orbicularis); Smirnov, 1966b:339–340.

Material. Several females from Geffard West (Victoria, Australia) and from ponds in Mengere, New Zealand. Preparations: MGU – female 2223, ephippial female 665. ZIN – female 2225, ephippial female without head shield 1443, head shield of female 680.

Female. Maximum height approximately equal to length. Maximum width slightly more than half the height. Ventral margin of valve with short feathered setae along its whole length. Sides of head with S-shaped fornices. Head shield with produced anterior margin but without pointed apex; posterior margin rounded.

Antennules conical, not reaching apex of rostrum. Anterior margin of antennules forming a proximal corner with an apical seta. Esthetascs on apex of antennules of equal length. Rami of antennae of nearly equal length. Distal segments of rami of antennae with 3 setae. First and second segment of exopodite of antennae with one seta. Endopodite of antennae with one spine on outer side of first segment and another spine on distal segment. Plate of labrum pointed. Maxillules with 3 crescent-shaped, feathered setae and a spine (also pubescent) lateral to the setae. The entire dorsal margin has a keel in the area of the ephippium in ephippial females.

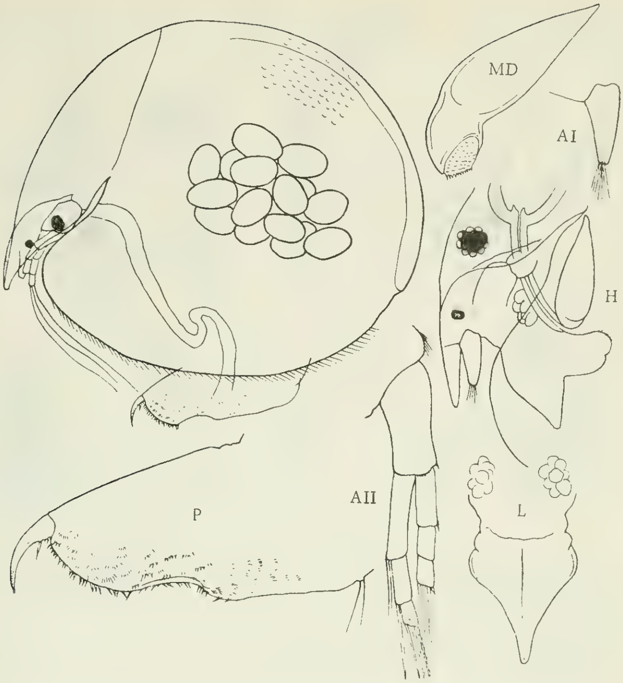

FIGURE 196. Saycia cooki, ephippial female, length 1.67 mm (Geffard West, Victoria, Australia, 22 August 1961, preparation 665):

AI – left antennule, dorsal view, preparation 680; L – labrum, anterior view, showing the paired glands. AI, AII, MD, H, L – after Sars, 1904a.

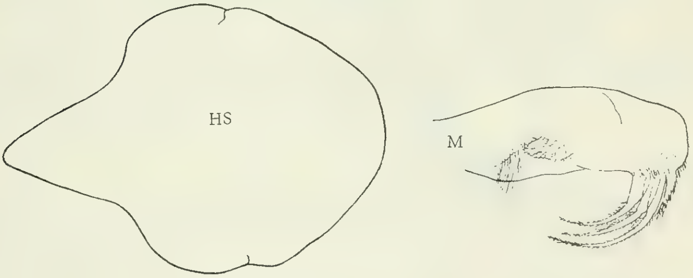

FIGURE 197. Saycia cooki, female:

M – Geffard West; HS – after Frey, 1967a.

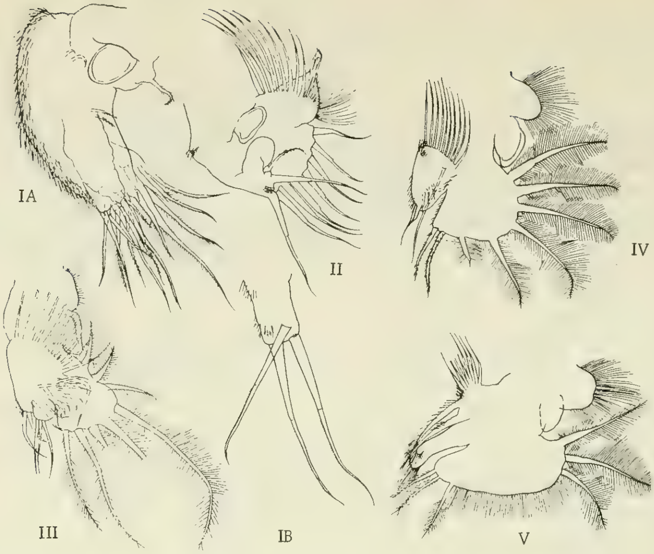

FIGURE 198. Legs of female of Saycia cooki, left side (Geffard West, Victoria, 22 August 1961):

IA, III, IV, V — outer side; IB — outer ramus of endite, inner view; II — inner view.

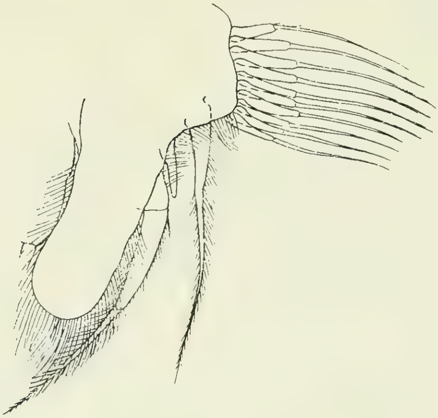

FIGURE 199. Endite and gnathobase of leg V of Saycia cooki (right leg, outer view; New Zealand, Mangere, May 1965)

215 Postabdomen tapering, concave in middle of dorsal margin. Claw with 2 basal spines. Anal denticles small, in groups. Anal margin and adjacent areas with groups of setae.

Leg I with regularly distributed setules (not in rows) on anterior side. Outer ramus of endite with 3 setae of about equal structure and size. Exopodite with similar setae. Leg II with 8 hard setae. Adjacent row of soft setae absent. Exopodite with 1 long and 1 short seta. Hard setae of endite of leg II (especially the longest seta) and the long seta on the exopodite of leg II resembling setae of outer ramus of endite and of exopodite of leg I. Leg III with a large exopodite with 8 setae, 3 of them situated on dorsal side of exopodite, 5 on posterior side. Endite of leg III with 8 hard setae and a parallel row of 7 soft setae. Filtering fan of gnathobase with 13 setae. Preepipodite present, but little differentiated. Leg IV with a large exopodite with 8 setae, seta 4 being the shortest. Endite of leg IV with 4 hard setae and a parallel row of 5 soft setae; filtering fan of gnathobase of leg IV with 10 setae. Large seta of gnathobase curved in the same direction as the hard setae of the endite which projects markedly beyond the last of the setae. Preepipodite lobed. Leg V with a large oval exopodite with 6 setae, 3 of them on the anterior side, the others on the posterior side. Preepipodite lobed. Epipodites without processes.

The drawings of legs I, II, and III of King (1866, Plate XIII) differ little from those of Sars (1904a).

According to Sars (1904a), the margins of the exopodite of leg IV bear 8 setae (correct), but the drawing of King (1866, Plate XIII) shows 10 such setae. The two anterior setae are sparsely pubescent, the others are feathered. The drawings of leg V by King (1866, Plate XIII) and by Sars (1904a) are similar.

Eurycercus cookii as illustrated by King (1866) is identical with Saycia orbicularis by Sars (1904a) and with our drawings, which proves that the authors described the same species.

The intestine forms loops. Ocellus situated closer to the eye than to the apex of the rostrum. There may be more than 20 eggs.

The genus Saycia is well characterized by its morphology, including that of the legs. Saycia differs distinctly from Eurycercus and from the other Chydoridae, and Sars therefore did not place it in the subfamilies known at the time. Saycia cooki may be 1.7 mm long.

Male. Unknown.

Distribution. Australia and New Zealand. King (1866) found it near Sydney and Brisbane.

III. Subfamily CHYDORINAE Stebbing, 1902

Frey, 1967a:36.

Type genus: Chydorus.

Height of body slightly larger than width. Horizontal keels present in some species. Mandibles articulated with head shield some distance from its margin. Head pores situated in median line of head shield, separated; two small pores between the main pores. Small pores without canals.

The setae of the ventral margin of the valves of some genera of this subfamily are situated on the inner side of the valve in the posterior part of the margin. The genera Chydorus, Dunhevedia, Anchistropus, and Dadaya, which differ distinctly from each other, belong to this group. In the other genera, viz., Pleuroxus and Alonella, all setae on the ventral margin of the valves are situated on the margin. It is difficult to distinguish between these two genera. Most synonyms using the name "Pleuroxus" concern species of the genus Alonella (see p. 318).

The genera with rows of setae situated on the inner side of the posterior half of the ventral margin of the valve (Chydorus, Dunhevedia, Dadaya, Anchistropus) are more specialized than Pleuroxus and Alonella, in which all setae of the ventral margin of the valve are situated on the margin. (These setae are situated on the margin in the most primitive Chydoridae.)

Anus situated in proximal part of postabdomen. The claws of the female bear two basal spines in most species; in Dunhevedia, Dadaya, and some other species, the claws bear only one spine.

Five to six pairs of legs. Leg VI, if present, without epipodite. Endite of leg II with 8 hard setae, without soft setae. Exopodite of legs IV and III with 7 setae. Hepatic processes absent. Length 0.2–0.7 mm.

The subfamily Chydorinae shows the greatest ecological specialization in the Chydoridae. It contains benthopelagial, benthic, and phytophilic forms, inhabitants of the open littoral, a neustonic species (Dadaya), a
216 necrophagous species (Pseudochydorus), and species which live on Hydra (Anchistropus). Some species of Chydorinae have a cosmopolitan distribution and attain a large density in places where other Chydoridae are absent. The species of this subfamily are small.

Key to Genera of the Subfamily Chydorinae according to Females

1 (2). Length less than 3.6 mm. Fossil.. †3. **Propleuroxus** N. N. Smirnov, 1970 (p. 216).
2 (1). Length less than 1 mm. Recent.
3 (8). Valves with setae on the entire posterior margin.
4 (5). Height of posterior margin of valve about one third of maximum height of the body (if more, postabdomen comparatively long and slightly curved)............ 4. **Pleuroxus** Baird, 1843 (p. 217).
5 (4). Height of posterior margin of valve about half the maximum height.
6 (7). Antennules ending at a distance of less than their own length from apex of rostrum or projecting beyond it .... 5. **Alonella** Sars, 1862 (p. 258).
7 (6). Antennules ending more than their length from apex of rostrum .... 6. **Disparalona** Fryer, 1968 (p. 271).
8 (3). Valves with setae situated on ventral margin in anterior half and on inner side of ventral margin in posterior half.
9 (16). Ventral margin of valve without incision.
10 (15). Labrum with plate-shaped process.

11 (14). Eye and ocellus small.
12 (13). Spherical. Postabdomen not oval, anus situated on its functional ventral side . . . . 7. Chydorus Leach, 1816 (p. 277).
13 (12). Oval. Postabdomen oval, anus situated on its functional posterior side. 8. Dunhevedia King, 1853 (p. 319).
14 (11). Eye and ocellus very large . . . . . . 9. Dadaya Sars, 1901 (p. 324).
15 (10). Labrum without plate-shaped process . . . . 10. Pseudochydorus Fryer, 1968 (p. 328).
16 (9). Ventral margin of valve with a denticle and an incision behind it . . . . 11. Anchistropus Sars, 1862 (p. 329).

Key to Genera of the Subfamily Chydorinae according to Head Shields (Recent)

1 (14). Two main head pores.
2 (7). Distance from posterior head pore to posterior margin of head shield longer than distance between main pores.
3 (4). Rostrum long. Distance from apex of rostrum to posterior end of fornix slightly longer than distance from posterior end of fornix to posterior margin of head shield . . . . 4. Pleuroxus.
4 (3). Rostrum short. Distance from apex of rostrum to posterior end of fornix much longer than distance from posterior end of fornix to posterior margin of head shield. Head shield rarely without pores.
5 (6). Rostral part of head shield without combs . . . . 7. Chydorus.
6 (5). Rostral part of head shield with combs parallel to margin of rostrum . . . . 10. Pseudochydorus.
7 (2). Distance from posterior head pore to posterior margin of head shield shorter than distance between main pores.
8 (11). Head pores situated some distance from posterior margin of head shield.
9 (10). Rostrum blunt . . . . 8. Disparalona
10 (9). Rostrum pointed . . . . 11. Anchistropus.
11 (8). Head pores situated at posterior margin of head shield; if displaced anteriorly, head shield with distinct lines or reticulated.
12 (13). Head shield with blunt or short rostrum . . . . 5. Alonella.
13 (12). Head shield with long pointed rostrum . . . . 6. Disparalona.
14 (1). Head pore single . . . . 9. Dadaya.

†3. Genus Propleuroxus N.N. Smirnov, 1970

Smirnov, N.N. 1970b:99–100.

Valves oval, without processes or denticles, with convex dorsal and ventral margin. Postabdomen elongate, slightly tapering. Three to four times as large as recent Chydorinae and Aloninae. Differs from Eurycercinae and Sayciinae in the narrow postabdomen and the form of the valve.

Type species: Propleuroxus freyi N.N. Smirnov, 1970.

217 1. Propleuroxus freyi N. N. Smirnov, 1970 (Figure 200)

Smirnov, N. N. 1970b:99.

Material. Imprint from Upper Permian (right and left valve).
Holotype. Paleontological Institute, Academy of Sciences of the USSR, No. 2500/563.

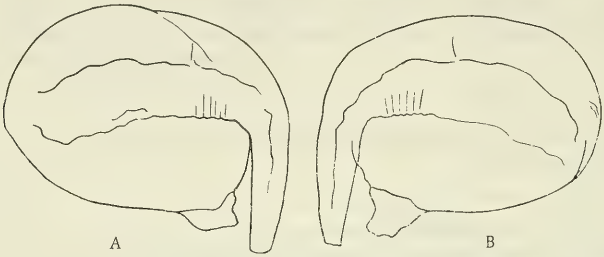

FIGURE 200. Propleuroxus freyi. Imprints:
A – right side, 2500/563; B – left side, 2500/563a.

Valve oval. Postabdomen elongate, tapering. If the longitudinal fold in the anterior part of the postabdomen is considered as imprint of the intestine, then the anus is situated in the distal part of the postabdomen. The lobe in the posterior part of the ventral margin of the valve is apparently a part of the valve which is curved outward. Length 3.6 mm.
Distribution. Eastern Kazakhstan (Karaungir River).

4. Genus Pleuroxus Baird, 1843

O. F. Müller, 1785:74–76 (Lynceus, part); Linné, 1788 (Monoculus, part); Jurine, 1820:1 (Monoculus, part: division Monocles à coquille univalve); Baird, 1843:93 (subgenus Pleuroxus), 94 (subgenus Peracantha); 1850:134 (Pleuroxus), 136 (Peracantha); Schoedler, 1863:39–40 (Peracantha), 44 (Pleuroxus), 54 (Rhypophilus); Kurz, 1875, 5:68 (Peracantha), 70–71 (Pleuroxus); Herrick, 1884:206–208 (Section Pleuroxus verus); Stingelin, 1895:250; Lilljeborg, 1900:520–521 (Peratacantha), 527–528 (Pleuroxus); Sars, 1901:78; 1916:342; Vereshchagin, 1923:32–33 (Cornuella); Wagler, 1937:60 (Peracantha, Pleuroxus); Bergamin, 1940:48; Bening, 1941:266 (Peracantha), 276 (Pleuroxus); Šrámek-Hušek et al., 1962:367–368 (Peracantha), 369 (Pleuroxus); Herbst, 1962:94–96 (Peracantha); 96 (Pleuroxus); Smirnov, 1964:305–318; 1966b:161–194.

Type species: Pleuroxus aduncus (Jurine, 1820).
Dorsal margin convex. Posterodorsal corner much lower than highest point of dorsal side. Setae of ventral margin situated on outer margin of valve, not on the inner surface.

The number of denticles on the posteroventral corner of the valve varies markedly. However, the general form of the denticles and their variation can be used to determine species. Thus, the denticles of P. aduncus are small, their width at the base often less than their maximum width, and are directed anteriorly. The denticles of P. trigonellus are short but relatively wider and directed anteroventrally. P. uncinatus has well developed denticles directed mainly posterodorsally. According to Spandl (1923b), a female P. truncatus with 12 denticles on the valve had young in which the number of denticles varied from 11 to 20; the number of denticles on the left and right valves was not always the same. A constant character of this species is the presence of more than 10 denticles on the posterior margin of the valve. The posteroventral corner of P. laevis and P. striatus bears only a single denticle. A specimen of P. striatus without denticles was found (preparation 367).

In the specimens examined, the length of the antennules is twice or more than twice the width; they have 9 esthetascs and a lateral seta situated in the middle of the antennule or distal to the middle. In the males of P. truncatus there is a second seta, situated proximal to the middle of the antennule.

The esthetascs differ in length by a factor of 2 or less. The antennae bear the following setae: 0–0–3/1–1–3. The distance from the head pores to the posterior margin of the head shield is larger than the distance between the main pores. The morphology of the legs of the females was uniform in all species examined.

218 The endite of leg I is divided into an outer part, which is more strongly chitinized and bears 3 large chitinized setae, and an inner part, divided into an anterior and a posterior lobe which bear respectively 4 and 3 feathered setae. Behind the posterior lobe of the inner part are 3 setae situated on the main stem of the endite and pointing in the same direction as the setae of the lobes. Basal to these setae there is another seta which is directed posteriorly. The upper part of the endite bears 2 short setae on the inner side. There are about 10 transverse rows of setae on the anterior surface of the endite.

The exopodite bears 2 setae, one very long, the other very short. One of the setae on the outer lobe of the endite is hook-shaped and shorter than the others; two other setae are unilaterally feathered to a varying extent (facing the outer lobe of the endite, which is directed anteroventrally).

The endite of leg II bears 8 crescent-shaped, chitinized setae at the posterior margin. The gnathobase is well developed with a row of filtering setae. The exopodite bears one moderately long seta. The endite is slightly cup-shaped, the convex side inward, so that the apex of the gnathobase and the row of filtering setae on the gnathobase are situated between the rows of legs, while the exopodite is curved outward and its seta is directed dorsally.

Leg III has a well developed, square exopodite. Endite and gnathobase are situated anterioventral to the leg. The row of filtering setae of the endite unites with the row of filtering setae of the gnathobase (which are longer). The filtering setae are pointed into the space between the legs. We found a sensilla on the gnathobase.

The data on the presence of 3 setae on the dorsal side of the exopodite correct those of Lilljeborg (1900), who found only 2 setae on the dorsal side of the exopodite of P. truncatus.

The exopodite bears 7 setae, 4 of them on the posterior side, the other 3 on the dorsal side. The anterior seta is relatively small and sparsely pubescent, the following 3 setae are long and feathered (2–4 times as long as the width of the exopodite), and the 3 dorsal setae are short and feathered. The setae of the dorsal side of the exopodite are shorter or slightly longer than the exopodite.

Leg IV has a small endite and a gnathobase. The row of filtering setae on the gnathobase (which are longer) forms a continuation of the filtering setae of the endite. The filtering setae are directed inward, into the space between the legs. The exopodite is very large, rounded, with 7 feathered setae. The two anterior setae are sparsely feathered. We found a sensilla on the gnathobase of leg IV of P. aduncus and P. truncatus.

Leg V has an even less developed endite and gnathobase. The exopodite is very large, oval. It bears 4 feathered setae, 3 of them on the posterior side, the fourth on the anterior side. The exopodite has 2 pubescent processes anteriorly (Lilljeborg, 1900 illustrated only one process in P. truncatus). There are only 2 setae on the endite.

The epipodites are situated in the posterodorsal part of legs I–V, lateral to the other part of the leg. The epipodites either have no processes or small processes which are not longer than the wide part. Legs IV and V have a large pubescent lobe, the preepipodite, above the epipodite.

Lev VI forms a small process in P. striatus at a considerable distance from leg V.

Leg I of the male P. truncatus bears a hook and an accessory seta on the outer lobe of the endite. The ventral part of the anterior side of the endite bears a dense row of long setae. The other legs do not differ from those of the female.

The claws of the female have two basal spines.

The intestine forms loops and has a caecum. Ocellus smaller than the eye, except in P. pamirensis. The vasa deferentia open at the base of the claws.

In the original description of Baird (1843:93, as a subgenus) it is stated that the anterior margin extends into the upper part, that the lower part is truncate, and that the first pair of legs are very large. Baird refers to the posterior margin as the lower margin and to the lower margin as the anterior margin.

Leg I of the species of Pleuroxus is not large compared with other genera. This statement of Baird (1843) may be attributed to the insufficient data on Chydoridae at his time.

The process in the anterior half of the ventral margin of the valve and the straight posterior margin are not special characters of Pleuroxus.

Thus, nothing remains of the diagnosis of the genus Pleuroxus given by Baird (1843). However, Pleuroxus contains characteristic species and is still recognized by many authors, but its diagnosis should be based on recent data. The species of Pleuroxus vary in the morphology of the head pores and legs.

It was almost impossible to distinguish between Alonella and Alona until recently. These genera are now easily distinguished by the structure

of the head pores and the exopodite of leg IV. The main difficulty is to
219 distinguish between Pleuroxus and Alonella, the head pores and legs
of which are of the same type.

The descriptions of Pleuroxus and Alonella by Lilljeborg (1900) do not give distinct differences between these genera.

Frey (1959, 1962a) stated that the distance from the posterior head pore to the posterior margin of the head shield is less than the distance between the pores in Alonella, and that the opposite is the case in Pleuroxus. However, there are no data on the head pores of many species of these genera. At any rate, Pleuroxus and Alonella should be considered as separate genera until further data become available.

The genus Peracantha Baird, 1843 with the single species Peracantha truncata is certainly a synonym of Pleuroxus. The only difference in Peracantha is the large number of denticles on the posterior and anterior margin of the valves. However, Pleuroxus procurvus Birge, 1879 has 7 denticles on the posterior margin of the valve and a hook-shaped rostrum. This species can be considered as transitional to P. uncinatus. The genus Cornuella Werestschagin, 1923 with the single species C. pamirensis Werestschagin, 1923 is also a synonym of Pleuroxus. This genus was established because of the presence of lateral processes on the valves. However, lateral processes of the valves also occur in the genus Chydorus (Chydorus bicornutus). The morphology of the legs of Cornuella pamirensis is characteristic of the genus Pleuroxus.

The species of Pleuroxus can be arranged in groups according to their form:

Elongate, with elongate postabdomen	Short, with truncate distal margin of postabdomen	Short, with rounded distal margin of postabdomen	Rounded, with narrowed, rounded distal margin of postabdomen
P. laevis	P. similis	P. aduncus	P. letourneuxi
P. striatus	P. denticulatus	P. hastirostris	P. caca
P. hamatus	P. toumodensis	P. trigonellus	P. pamirensis
		P. uncinatus	
		P. truncatus	
		P. procurvus	

Bergamin (1940:48) published a similar classification of the species of Pleuroxus.

Key to Species of the Genus Pleuroxus according to Females

1 (28). Valves without lateral hornlike processes.
2 (27). Integument smooth.
3 (26). Elongate (ratio of length to height not less than 1.3, to 2).
4 (23). Posterior margin of valve without denticles (denticles may be present on the posteroventral corner, but not more than 6).
5 (22). Apex of rostrum directed ventrally.
6 (17). Length 1.3–1.5 times the height; if more, postabdomen with truncate distal margin.

7 (12). Postabdomen with rounded distal margin.
8 (11). Anal denticles small.
9 (10). Anal denticles irregularly distributed. Antennules ending at a distance equal to their own length before apex of rostrum . . . . 1. **P. aduncus** (Jurine, 1820).
10 (9). Anal denticles regularly distributed. Antennules ending at a distance of less than their own length from apex of rostrum . . . . 2. **P. hastirostris** Sars, 1904.
11 (8). Anal denticles small . . . . . . 3. **P. trigonellus** (O. F. Müller, 1785).
12 (7). Postabdomen with truncate distal margin.
13 (16). Anal denticles large, uniformly spaced.
14 (15). Anal denticles 14–16, gradually decreasing in size proximally . . . . 4. **P. similis** Vavra, 1900.
15 (14). Anal denticles 8–12, four distal denticles much larger than the others . . . . 5. **P. denticulatus** Birge, 1879.
16 (13). Anal denticles small, in groups . . . 6. **P. toumodensis** Brehm, 1934.
17 (6). Length 1.6–1.7 times the height. Postabdomen with rounded, dorsal, distal margin.
18 (19). Dorsal margin more strongly convex than ventral margin (ventral margin almost straight). Slightly yellowish . . . . 7. **P. laevis** Sars, 1862.
19 (18). Dorsal and ventral margin almost equally convex.
20 (21). Postabdomen with 20–21 anal denticles. Posteroventral corner with denticle (rarely without denticle). Blackish . . . . 8. **P. striatus** Schoedler, 1858.
21 (20). Postabdomen with 12–14 anal denticles. Posteroventral corner without denticles . . . . 9. **P. hamatus** Birge, 1879.
220
22 (5). Apex of rostrum hook-shaped, curved anteriorly . . . . 10. **P. uncinatus** Baird, 1850.
23 (4). Posterior margin of valve with 6 denticles or more.
24 (25). Apex of rostrum directed ventrally . . . . 11. **P. truncatus** (O. F. Müller, 1785).
25 (24). Apex of rostrum hook-shaped, curved anterodorsally . . . . 12. **P. procurvus** Birge, 1879.
26 (3). Outline of body almost round (ratio of length to height about 1.2). . . . . 13. **P. letourneuxi** (Richard, 1888).
27 (2). Integument rugose . . . . 14. **P. caca** Harding, 1955.
28 (1). Valves with lateral hornlike processes . . . . 15. **P. pamirensis** (Werestschagin, 1923).

Key to Species of Known Males of the Genus Pleuroxus

1 (16). Postabdomen tapering.
2 (13). Posterior margin of valve without denticles.
3 (12). Oval.
4 (11). Ventral and dorsal margin of postabdomen not parallel.
5 (8). Antennules not reaching apex of rostrum.
6 (7). Posteroventral corner with a denticle . . . . 7. **P. laevis**.
7 (6). Posteroventral corner without denticle . . . . 9. **P. hamatus**.

8 (5). Antennule reaching apex of rostrum.
9 (10). Postabdomen long . . . . 8. **P. striatus.**
10 (9). Postabdomen short . . . . 1. **P. aduncus.**
11 (4). Ventral and dorsal margins of postabdomen nearly parallel . . . . 5. **P. denticulatus.**
12 (3). Spherical . . . . 13. **P. letourneuxi.**
13 (2). Posterior margin of valve with denticles.
14 (15). More than 10 denticles . . . . 11. **P. truncatus.**
15 (14). Not more than 8 denticles . . . . 12. **P. procurvus.**
16 (1). Postabdomen strongly tapering, triangular.
17 (18). End of postabdomen produced into narrow part . . . 3. **P. trigonellus.**
18 (17). End of postabdomen not produced into narrow part . . . . 10. **P. uncinatus.**

1. **Pleuroxus aduncus** (Jurine, 1820)

Harding, 1955:348–350, Figures 83–92 (review of different forms); Negrea, 1966a:147–148.

Female. Height of posterior margin of valve one third of maximum height. Posteroventral corner of valve with 1–3 denticles directed posteriorly. Denticles sometimes absent. Ventral margin convex in the middle, with feathered setae. Anterior margin serrated. Valves with lines in ventral part. Rostrum long, pointed, directed downward. Head pores typical of subfamily. Antennules reaching to middle of rostrum. Antennules with a sensory seta in middle of anterior margin. Setae on antennae: 0–0–3/1–1–3. Plate of labrum convex anteriorly, with slightly pointed apex.

Postabdomen short, tapering distally. Preanal corner hardly projecting. Anus with slightly concave margin. Postanal margin of postabdomen with 10–12 small anal denticles which decrease in size proximally and are partly arranged in groups. Lateral setae present. Claw with 2 denticles at the base. Legs typical of the genus. Outer ramus of endite of leg I of female with 3 setae; 2 of them brushlike, of about equal length, the third seta hook-shaped, half as long. Intestine forming loops. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum.

Harding (1955) noted the great diversity of the forms identified as P. aduncus. The posteroventral corner of the valve of the female may have no denticles or 1 to 3; the right and left valves may bear a different number of denticles. The lines in the anterior part of the valves may be distinct or indistinct. The ratio of length to width of the antennules may vary from 1.8 to 4; the antennules may be 0.36 to 0.65 of the length of the rostrum. The postanal margin of the postabdomen may be straight, convex, or concave. The rod-shaped appendage at the base of the antennules may be present or absent. Its absence is usually associated with wider and shorter antennules and a narrower postabdomen. In such specimens the anal denticles may be larger and less distinctly grouped, i.e., resembling those of P. trigonellus (however, the males of these two species differ distinctly). Length, according to material from the Gorki Reservoir (25 August 1961): 0.36 (first stage) to 0.66 mm, minimum length of gravid females 0.5 mm (third stage).

221 Male. Valve with denticulate posteroventral corner. Rostrum less pointed. Antennules more than half length of rostrum. Antennules with 2-segmented flagellum distal to middle of anterior margin; sensory seta situated distal to flagellum. Postabdomen tapering distally. Dorsal margin of postabdomen with anal setae in distal part which continue on the lateral surface. Claws with one basal spine. Ocellus situated halfway between eye and apex of rostrum. Vas deferens opening at base of claw, ventral to it. Length up to 0.46 mm.

Juvenile male. Postabdomen resembling that of female. Claws with 2 basal spines. Antennules ending a short distance from apex of rostrum.

Key to Subspecies of P. aduncus according to Females

1 (6). Valve without semicircular depressions.
2 (5). Postabdomen tapering distally.
3 (4). All anal denticles forming irregular groups . . . . 1a. **P. aduncus aduncus** (Jurine, 1820).
4 (3). Five distal anal denticles relatively large and separate . . . . 1b. **P. aduncus transcaucasicus** Shiklejew, 1933.
5 (2). Postabdomen strongly widened distally . . . . 1c. **P. aduncus laticaudatus** Brehm, 1933.
6 (1). Valve with semicircular depressions in posterior ventral part . . . . 1d. **P. aduncus caelatus** Weigold, 1971.

1a. Pleuroxus aduncus aduncus (Jurine, 1820)

(Figures 201–203)

Jurine, 1820:152–153, Plate 15, Figures 7, 8 (Monoculus aduncus); Baird, 1834 (hamatus); Edwards, 1840, Plate 3:387 (Lynceus); Lilljeborg, 1853:80, Plate IX, Figure 1 (trigonellus); Schoedler, 1858:27 (Chydorus); 1862:25; 1863:46; Plate 3, Figure 59; Studer, 1878:109, Plate IV, Figures 4, 4a, 4b (wittsteini); Sars, 1896b:31–35, Plate 5, Figures 8–9 (inermis); Ekman, 1900:78–81, Plate 4, Figures 25–29 (P. scopuliferus); Lilljeborg, 1900:541–545, Plate LXXV, Figures 11–17 (aduncus); Daday, 1902:262–263 (scopulifer); Sars, 1903a:185, Plate VIII, Figures 4, 4a; 1904:57–58, Plate 5, Figure 2 (scopulifer); Baker, 1912:117, Figure 64 (Chydorus simplex); Arevalo, 1916:62, Figure 26 (morotei); Sars, 1916:342, Plate 41, Figures 2, 2a–b (inermis); Henry, 1919:480–481, Plate XLII, Figures 15, 16 (Chydorus denticulatus syn. n.); Rühe, 1921:51–53, Figures 18a, b (wittsteini); Gauthier, 1929:153–155, Figure 7 (aduncus); Harding, 1955:348–350, Figures 83–92; Frey, 1960:696, Figures 20–25; Šrámek-Hušek et al., 1962:381–383, Figure 143 (aduncus); Smirnov, 1964:305–318 (aduncus); 1966c, Figures 7, 23 (aduncus).

Material. Numerous females from the Volga reservoirs of Rybinsk, Gorki, Kama, and Kuibyshev, tributaries of the Rybinsk Reservoir, the rivers Il'd and Sutka, the Lenkoran' district, Lake Issyk-Kul', the Elovskii pond at the Angara (Irkutsk Region), Lake Kadil'noe (shore of Lake Baikal

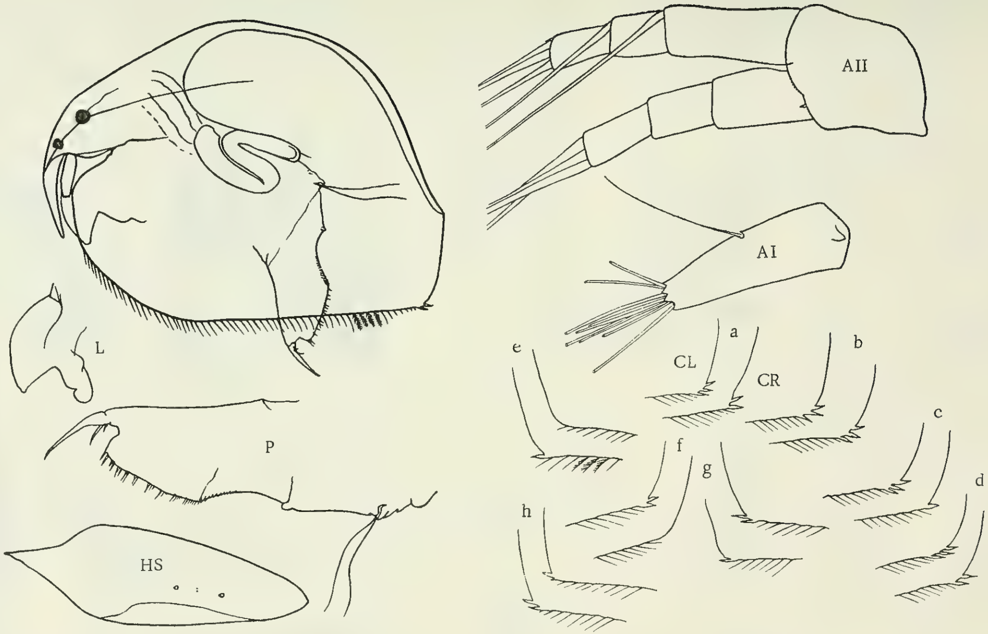

FIGURE 201. *Pleuroxus aduncus aduncus*, female, length 0.43 mm (Il'd River, 10 August 1962): HS – head shield of exuviae of 6th stage, length 540 μ; AII – right antenna, ventral-inner view; AI – left antennule, ventral view; a–h – posteroventral corners of valves (Kuibyshev Reservoir, 17 July 1961, preparations 783, 767, 765, 775, 772, 763, 762, 761).

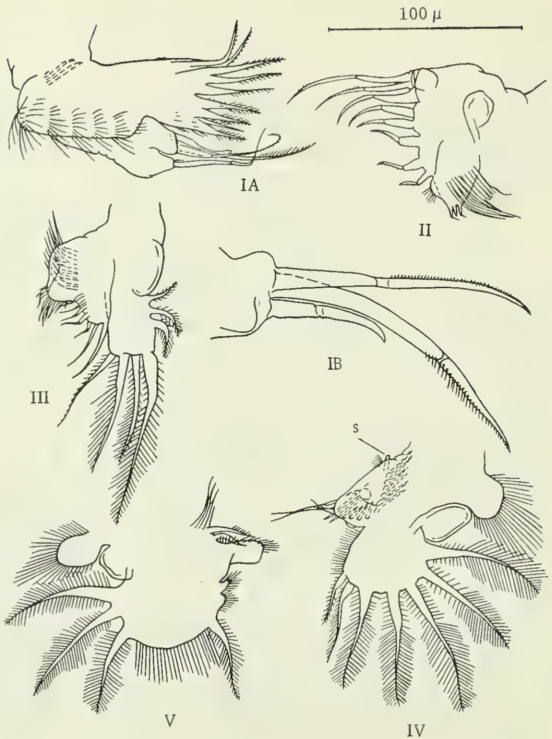

FIGURE 202. Leg of female of Pleuroxus aduncus, left side (Il'd River, 10 August 1962):

IA, II, III, IV – inner view; IB – outer ramus of the endite; V – inner view.

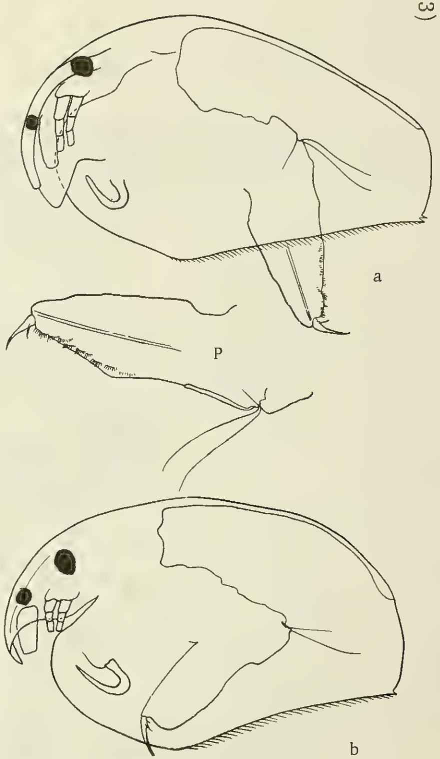

FIGURE 203. Pleuroxus aduncus aduncus:

a – adult male, length 0.42 mm (Lake Kadil'noe, shore of Lake Baikal near Bol'shie Koty, 21 August 1949, preparation 138); b – juvenile male, length 0.34 mm (small lake in the Uryukhta area – north coast of Issyk-Kul', 12 October 1965, preparation 944).

north of Bol'shie Koty), and Makuori Island. Several females from lakes in the Aktyubinsk and Dzhambul regions. Numerous males from the Rybinsk Reservoir. Several males from a small lake at the north shore of Lake Issyk-Kul'. One male from Lake Kadil'noe. Preparations: MGU – females 1049, 390, 2539 (Kerguelen Island), a deformed female 1953, males 2931, 138. ZIN – female 720, male 2029.

Female. Valve without semicircular depressions. Postabdomen not widened distally but tapering. Anal denticles small, irregularly distributed, forming groups. Antennules with 9 esthetascs distally, differing only slightly in length, with one seta in the middle.

Outer ramus of endite of leg I with 2 long and one short setae. Endite of leg III with 7 hard setae in 2 groups, one of them consisting of the short setae 2–5, the other of the short seta 6 and the long setae 7 and 8. Endite with 6 soft setae. Filtering fan of gnathobase with 8 setae. Length to 0.52 mm.

Male. Postabdomen with groups of lateral setae, the distal seta projecting beyond margin of postabdomen. Claws with a basal spine. Outer ramus of endite of leg I with 3 setae of similar length (Figure 122). Length 0.44 mm.

Distribution. Cosmopolitan.

1b. **Pleuroxus aduncus transcaucasicus** Shiklejew, 1933 (Figures 204 and 205)

Rühe, 1921:21, Figure 5c (aduncus); Shikleev, 1933:85, Figures 22, 23 (var. transcaucasica); Jenkin, 1934:296, Figures 19–22 (var. makaliensis).

Material. British Museum 77.1939.4.25.24–27 (female and male).

Female. Postabdomen with about 5 large anal denticles and about 10 groups of setae proximal to them. Lateral groups of setae present. Length 0.55 mm according to Jenkin (1933).

Male. According to Jenkin (1934) valves without lines. Posteroventral corner of valves with one denticle. Antennules with a basal process and with distal sensory papillae; middle of antennule with a sensory papilla and
225 an articulated sensory seta. Postabdomen with anal denticles and lateral setae. Postabdomen tapering distally. Preanal corner indistinct. Ventral margin with 3 incisions. Claws with setae on the concave margin and with one basal denticle. Ocellus closer to apex of rostrum than to eye. Vas deferens opening near and ventral to base of claws. Length 0.46 mm.

Distribution. Kenya, Cape Town, Caucasia.

1c. **Pleuroxus aduncus laticaudatus** Brehm, 1933 (Figure 206)

Brehm, 1933a:745, Figure 39 (var. laticaudatus).

Material. One female from a pond 10 km from river Angara (Irkutsk Region). Preparation: MGU – female 1414.

Female. Valve without depressions. Postabdomen widened distally. Ratio of length to height of distal part of postabdomen about 2:3.

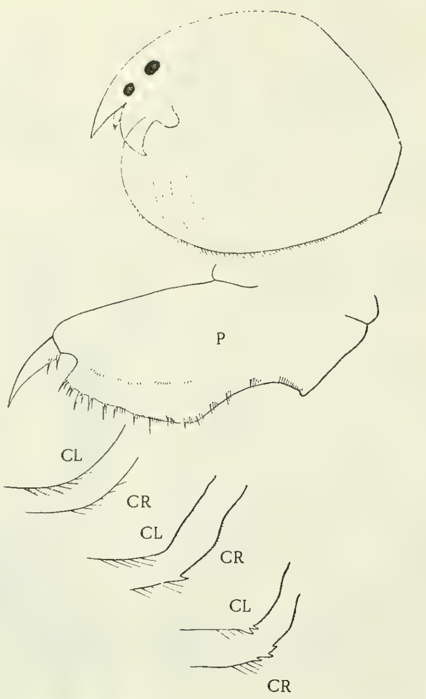

FIGURE 204. Pleuroxus aduncus transcaucasicus, female. Left side (after Shikleev, 1933):

P – after Shikleev, 1933; CL, CR – posteroventral corner of valve (after Jenkin, 1934).

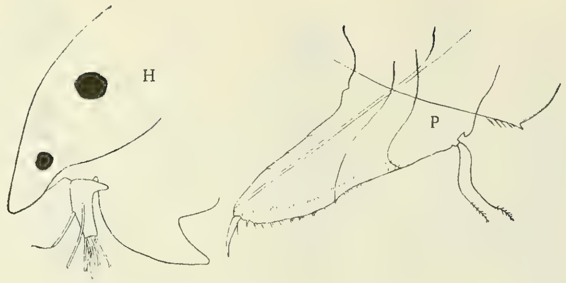

FIGURE 205. Pleuroxus aduncus transcaucasicus, male (after Jenkin, 1934)

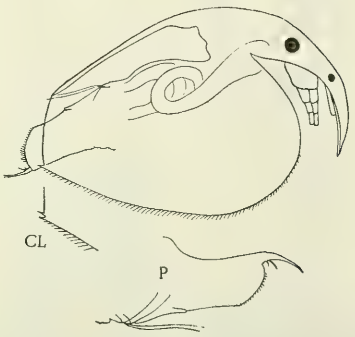

FIGURE 206. Pleuroxus aduncus laticaudatus, female, length 0.36 mm (pond 10 km from the Angara River, Irkutsk Region, 20 August 1946, preparation 1414)

Distribution. Northern Sumatra. We found a similar specimen in material from the Irkutsk Region (preparation 1414).

1d. **Pleuroxus aduncus caelatus** Weigold, 1911

Weigold, 1911:32, Figure 55.

Female. Distinguished by semicircular depressions in posterior ventral part of valve.

Distribution. Central Europe.

2. **Pleuroxus hastirostris** Sars, 1904 (Figure 207)

Sars, 1904b:635, Figures 8, 8a–c.

Material. Several families from a pond at Silverdale, New Zealand.

Female. Maximum height before the middle. Valves with well developed posterodorsal corner. Posteroventral corner of valve with denticle. Maximum height 2.7 times larger than posterior margin. Valves without pattern. Ventral margin of valve with feathered setae. Rostrum pointed.

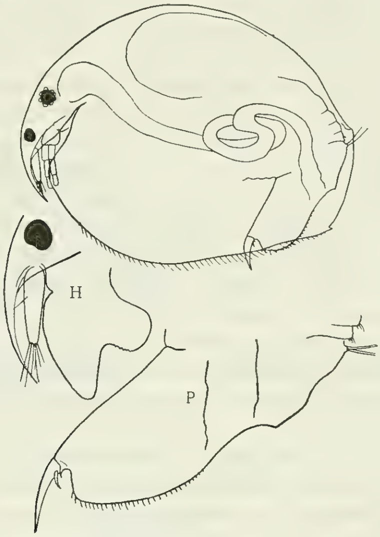

FIGURE 207. Pleuroxus hastirostris, female (after Sars, 1904b)

Antennules ending less than their own length from apex of rostrum. Antennae not reaching apex of rostrum. Plate of labrum with rounded apex. Postabdomen with rounded distal dorsal corner. Anal denticles small, numerous. Preanal corner distinct. Claws with 2 basal spines, proximal spine small. Intestine forming loops. Ocellus situated nearer to eye than to apex of rostrum. Length 0.42 mm.

Male. Unknown.
Distribution. New Zealand.

3. Pleuroxus trigonellus (O. F. Müller, 1785).

Female. Dorsal margin strongly convex. Maximum height of valve 3 times that of the posterior margin. Posteroventral corner of valve with 1–3 denticles; small spinules sometimes present above the denticles which are pointed posteriorly and downward. Valve with polygonal pattern. Rostrum long, pointed, directed ventrally. Head shield pointed posteriorly (Frey, 1959). Head pores typical of the subfamily. Plate of labrum with slightly pointed apex. Ventral margin of postabdomen with 2 incisions with spines. Antennules more than half as long as rostrum, with a sensory seta in middle of anterior margin. Esthetascs situated on distal margin. Distal segments of antennae not reaching end of antennules. Setae of antennae: 0–0–3/1–1–3. Plate of labrum with convex anterior margin.

Ratio of length to width of postabdomen 2.5. Anus sometimes with several setae on the concave margin. Anal denticles 10–14, increasing in size distally. Claws with setae on the concave margin and with 2 basal denticles. Intestine forming loops. Ocellus nearer to eye than to apex of rostrum. Legs typical of the genus. Outer ramus of endite of leg I with 3 setae, including 2 brushlike setae of almost equal length and a hook-shaped seta which is half as long. Length 0.6 mm.

226 Male. Ventral margin more strongly convex than dorsal margin. Posterior margin of valve straight, about a third of maximum height. Posteroventral corner of valves with varying denticles. Valve with fine dots. Rostrum short, blunt. Antennules reaching to apex of rostrum. Anterior margin of antennule with a 2-segmented flagellum and a sensory seta distal to middle. Antennae reaching to apex of rostrum.

Postabdomen with strongly convex dorsal margin and tapering distal part. Anal denticles in form of setae; lateral groups of setae present. Ventral side with incisions with setae in form of tubercles. Claws with one basal spine. Vasa deferentia opening at base of claw on ventral side of postabdomen. Opening of vas deferens surrounded by setae (Frey, 1958).

Intestine forming loops. Ocellus nearer to apex of rostrum than to eye. Length 0.51 mm.

Juvenile male. Rostrum long. Antennules ending far from apex of rostrum. Distal segments of antennae not reaching apex of antennules. Postabdomen tapering distally but not narrowed into a rodlike part as in adult males. Dorsal margin concave. Anal margin concave. Preanal corner distinct. There are 13–15 anal spinules. The developing adult form of the postabdomen is visible through the postabdomen. Claws with setae on the concave margin and with 2 basal spines. Intestine forming loops. Ocellus situated nearer to eye than to apex of rostrum. Hook of leg I less developed than in the adult male. Length of juvenile males to 0.39 mm. A similar young male was described by Lilljeborg (1900, Plate XXIV, Figure 23).

Biology. Lives in the vegetation.

Key to Subspecies of P. trigonellus according to females

1 (4). Posteroventral corner denticulate.
2 (3). Antennules reaching middle of rostrum . . . . 3a. **P. trigonellus trigonellus** (O. F. Müller, 1785).
3 (2). Antennules not reaching $^1/_3$ of length of rostrum . . . . 3b. **P. trigonellus brevicornis** Brehm, 1933.
4 (1). Posteroventral corner without denticles . . . . 3c. **P. trigonellus entzi** Kottász, 1913.

3a. **Pleuroxus trigonellus trigonellus** (O. F. Müller, 1785) (Figures 208–216)

O. F. Müller, 1785:74–75, Plate X, Figures 5, 6 (Lynceus trigonellus); Linné, 1788:3008 (Monoculus); Baird, 1843:93–94, Plate III, Figure 13, p. 94, Plate III, Figure 14 (Hammatus, syn. n.); Baird, 1850:134–135, Plate XVII, Figure 3 (trigonellus); 137, Plate XVII, Figure 5 (hamatus); Zaddach, 1844:28 (Lynceus); Schoedler, 1958:28 (ornatus); 1862:25, Plate II, Figures 33–36 (trigonellus), Figure 32 (ornatus); 1863:44–46, Plate II, Figures 33–36, 47, Plate II, Figure 32 (ornatus); 50–51 (bairdii); Lilljeborg, 1900:534–537, Plate LXXIV, Figures 13–23 (trigonellus); Daday, 1901b:450–451, Plate XXIII, Figures 6–9 (csikii syn. n.), Synonymized because the variation of the spines on the posteroventral corner of the valves of P. trigonellus includes the characters described for P. csikii; the two forms are identical in other characters); Delachaux, 1909:88–90, Figures 2, 3 (var. brevirostris); Birabén, 1939:667, Figures 20, 21 (similis); Bening, 1941:280–282, Figure 116 (trigonellus); Frey, 1959:40, Figures 58, 59; 1962a, Figures 58, 59 (trigonellus); Šrámek-Hušek et al., 1962:376–377, Figure 141 (trigonellus); Herbst, 1962:98, Figure 82 (trigonellus); Smirnov, 1966c, Figures 8, 13, 15, 16, 25 (trigonellus).

Material. Numerous females from the Cherepovets and Rybinsk reservoirs, from the Yakot' River (below Zhestylev, Moscow Region), and from Frolikh Inlet (northeastern part of Lake Baikal, depth 1 m). Several males from the Cherepovets Reservoir. Numerous males from the Rybinsk Reservoir. Preparations: MGU – female 1877, males 1833, 735, 382, juvenile male 1919, deformed females 393, 1630. ZIN – female 1881, male 1905, juvenile male 1912. Ph – female 1883, male 1903.

Female. Posteroventral corner with 1–3 denticles. Antennules reaching middle of rostrum. Both specimens with a short rostrum (Figure 101) were found in the Cherepovets Reservoir in a population with individuals with a rostrum of normal length. The rostrum of these specimens is apparently a malformation like the one observed in Chydorus sphaericus. Our specimens (preparations 393 and 1630) closely resemble the drawings of Delachaux (1909:88–90, Figures 2, 3).

Distribution. Holarctic Region, Java. Ubiquitous in the European USSR to the Ob' River in the east.

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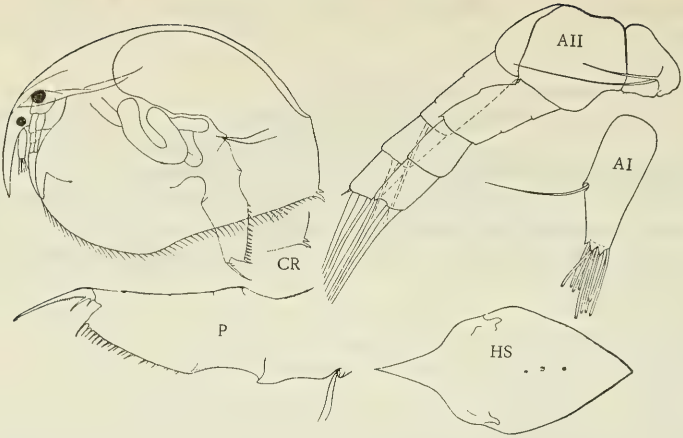

FIGURE 208. Pleuroxus trigonellus trigonellus, female, length 0.57 mm (Rybinsk Reservoir, 12 July 1962):

HS — after Frey, 1962a; AII — left antenna; AI — left antennule, outer view; AI, AII — Cherepovets Reservoir, 8 August 1963.

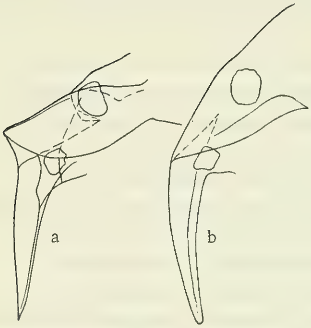

FIGURE 209. Head of females:

a — Pleuroxus uncinatus (pond on Yakot' fish farm, Moscow Region, 25 July 1967, preparation 2216); b — P. trigonellus Cherepovets Reservoir, 8 August 1963, preparation 394).

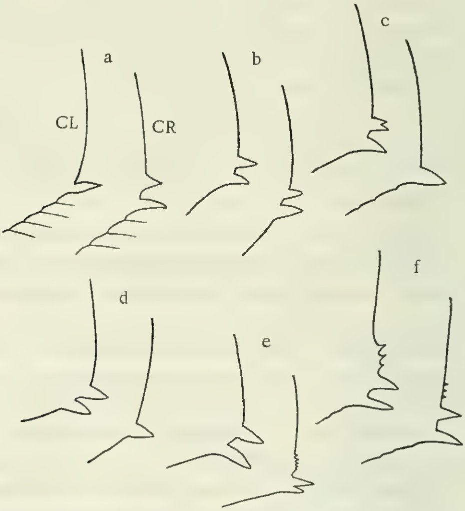

FIGURE 210. Pleuroxus trigonellus trigonellus, female, denticles on posteroventral corner of valve:

a–d — Cherepovets Reservoir, 21 October 1963; e — Cherepovets Reservoir, 8 August 1963; f — Rybinsk Reservoir, 15 August 1962.

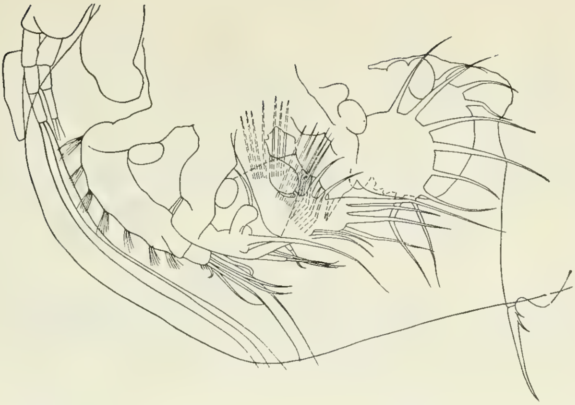

FIGURE 211. Arrangement of left legs of female of Pleuroxus trigonellus trigonellus, length 0.68 mm (Rybinsk Reservoir, 12 July 1962)

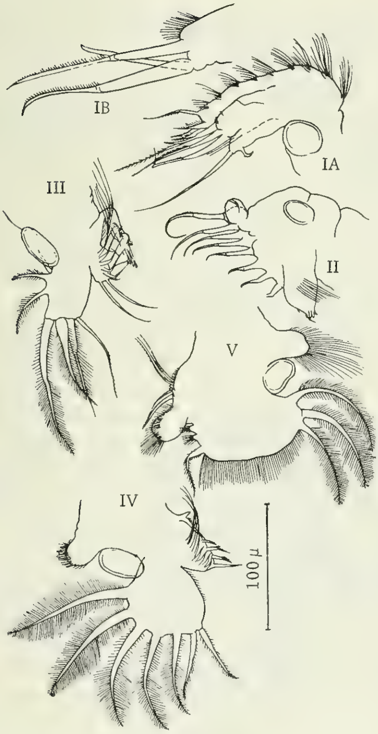

FIGURE 212. Legs of female of Pleuroxus trigonellus trigonellus, left side (Cherepovets Reservoir near the dam, 8 August 1963):

IA, II, V — outer view; IB — inner ramus of endite; III, IV — inner view.

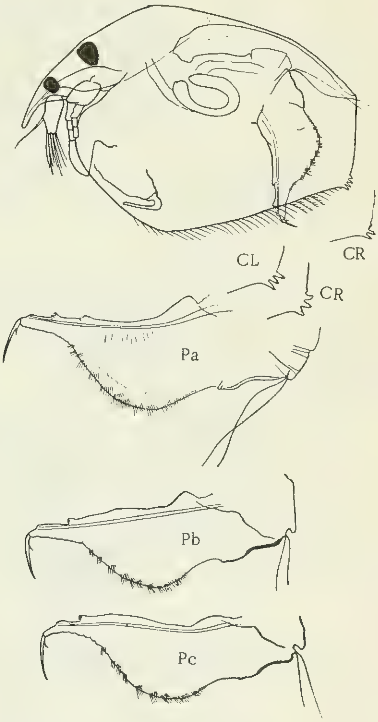

FIGURE 213. Pleuroxus trigonellus trigonellus, adult male and CR (Cherepovets Reservoir, Goritsy, 21 October 1963, preparation 735):

CL — Cherepovets Reservoir, preparation 382; Pa — preparation 735; Pb, Pc — Rybinsk Reservoir, culture, 27 July 1965.

(229)

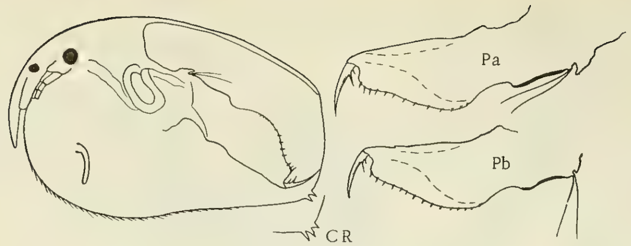

FIGURE 214. Pleuroxus trigonellus trigonellus, juvenile male, length 0.39 mm (Rybinsk Reservoir, culture, 24 July 1965, preparation 1919):

Pa – postabdomen; Pb – juvenile male, preparation 1912.

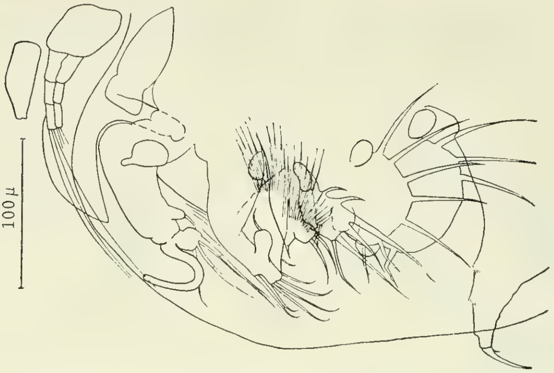

FIGURE 215. Arrangement of left legs of male of Pleuroxus trigonellus trigonellus (Cherepovets Reservoir near dam, 8 August 1963)

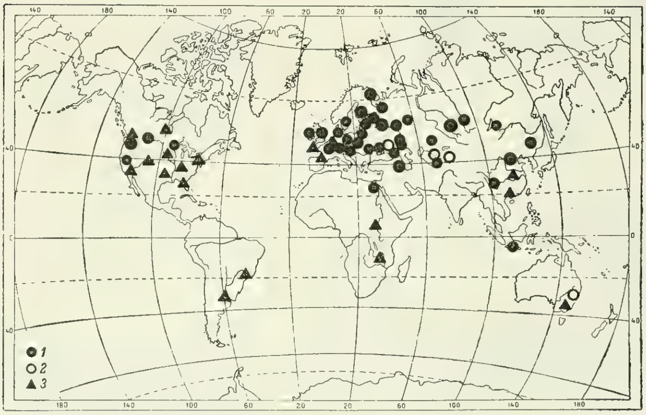

FIGURE 216. Distribution:

1 – Pleuroxus trigonellus trigonellus; 2 – P. similis; 3 – P. denticulatus.

3b. **Pleuroxus trigonellus brevicornis** Brehm, 1933
(Figure 217)

Brehm, 1933a:743, Figures 36, 37, 38 (var. brevicornis).

Female. Antennules very small, not reaching a third of rostrum. Valve with denticle in posteroventral corner. Valve without distinct sculpture. Distal side of postabdomen with 2–3 denticles. About 12 anal denticles altogether. Length 0.4 mm.

Distribution. Sumatra.

231 3c. **Pleuroxus trigonellus entzi** Kottász, 1913

Kottász, 1913:92 (var. entzii); Šrámek-Hušek et al., 1962:378 (var. entzii).

Female. Posteroventral corner of valve without denticles.

Distribution. Hungary.

4. **Pleuroxus similis** (Vavra, 1900 (Figures 216, 218, 219)

Vavra, 1900:23–24, Figure 6; Sars, 1901:79–80, Plate XI, Figures 7, 7a–b; Stingelin, 1913:624–625, Figures 24, 25 (similis var. fuhrmanni); Henry, 1922:45, Plate VII, Figure 3 (australis syn. n.); Manuilova, 1964:263, Figure 128; Smirnov, 1966c:192 (australis).

Material. Two females from Gagra; many females from Lake Issyk-Kul', from ponds of the Kalgan-Chirchik fish farm south of Tashkent. Preparations: MGU – female 924 (prepared by Shikleev). ZIN – several females in preparation 925 of Shikleev.

Female. Dorsal margin uniformly convex. Posterior margin straight. Maximum height 3.4 times length of posterior margin. Rostrum pointed, reaching level of ventral margin of valve. Valves without pattern. Ventral margin of valve with feathered setae. Posteroventral corner of valve with 3–4 denticles. Antennules ending far before apex of rostrum. Postabdomen slightly tapering. Dorsal distal corner of postabdomen situated slightly behind base of claws. Preanal corner blunt. There are 14–16 anal denticles. Claws with 2 basal spines.

Legs typical of the genus. Outer ramus of endite of leg I with 2 long setae and 1 short seta (about half length of long seta). Intestine with loops and with a caecum. Distance of ocellus to eye half its distance to apex of rostrum. Length 0.5 mm.

Male. Unknown.

Distribution. Australia, Valdivia (Chile), Northern Caucasus, Lake Issyk-Kul', Tashkent area.

5. **Pleuroxus denticulatus** Birge, 1879 (Figures 216, 220–222)

(Nec Chydorus denticulatus Henry, 1919). Birge, 1879:20–21, Plate I, Figure 21; Scourfield, 1907:73–75, Plate 8, Figures 5–10; Bergamin, 1940:49, Figure 2; Frey, 1959:39, Figure 53; 1960:696, Figures 17–18; 1962a, Figure 53; Shan and Frey, 1968:203–205; Shan, 1969:513–523.

(230)

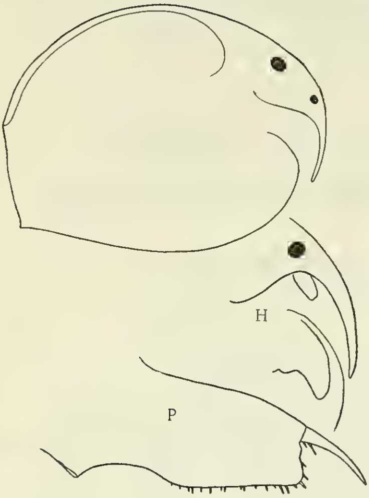

FIGURE 217. Pleuroxus trigonellus brevicornis, female (after Brehm, 1933a)

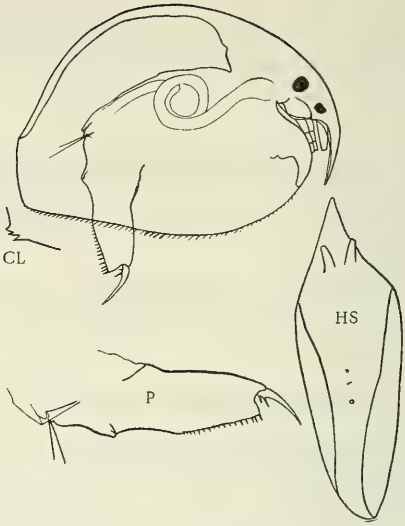

FIGURE 218. Pleuroxys similis, female, length 0.45 mm:

CL, P — Gagra, preparation 924; HS — Lake Issyk-Kul', 10 August 1964.

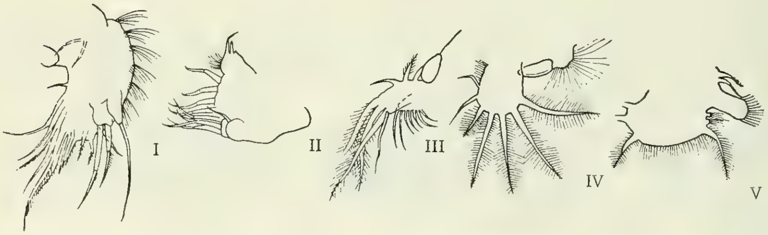

FIGURE 219. Legs of female of Pleuroxus similis (Lake Issyk-Kul', 10 August 1964): I, II, III — right legs, outer view; IV — right leg, inner view; V — left leg, inner view.

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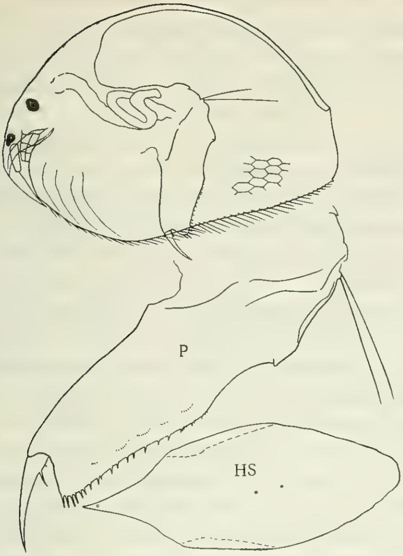

FIGURE 220. Pleuroxus denticulatus, female, length 0.43 mm (brook near Ballina, New South Wales, Australia, 18 August 1965, preparation 1901):

HS — after Frey, 1962a.

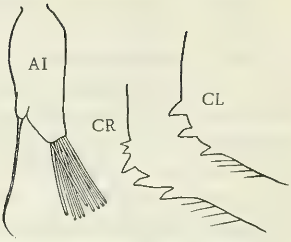

FIGURE 221. Pleuroxus denticulatus, female (after Scourfield, 1907)

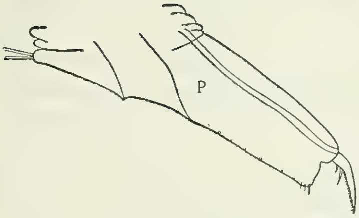

FIGURE 222. Postabdomen of male of Pleuroxus denticulatus (after Birge, 1892)

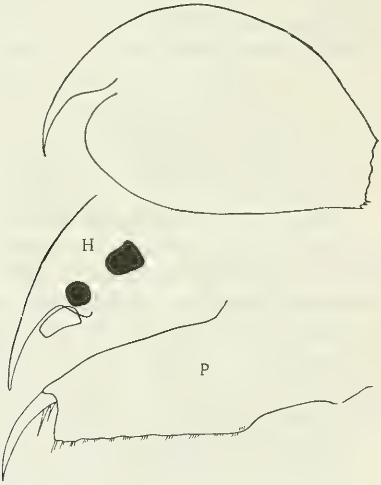

FIGURE 223. Pleuroxus toumodensis, female (Brehm, 1934a)

Material. Four females from Toulouse, France. Several females from the White Nile, from rivulets in New South Wales, Australia, and from Corrientes, Argentina. British Museum 77.1953.2.4.6 (W. A. Smith, Pond, Surrey). Preparations: MGU – females 1901, 2287. ZIN – females 507, 2288.

Female. Maximum height of valve 3.5 times the posterior margin. Posteroventral corner with one or several denticles or without them. Ventral margin denticulate anteriorly. Rostrum long, pointed. Posterior margin of head shield rounded. Head pores typical of the subfamily.

Antennules ending far from apex of rostrum. Esthetascs about equal in length. Lateral seta situated on a tubercle.

Distal margin of postabdomen straight, slightly more than twice as wide as base of claws.

The illustration of the postabdomen by Scourfield (1907) differs markedly from that of Birge (1879). However, Scourfield compared his material with that of Birge and concluded that they were identical. The much greater length of the three distal anal denticles compared with the other anal denticles is indicated in the text and in the drawing of Scourfield. According to Brooks (1959), the long distal dorsal corner of the postabdomen bears several denticles, with 8–12 anal denticles before them.

Groups of lateral setae present. Preanal corner only slightly projecting. Claws with 2 basal denticles, the distal ones much larger than the proximal. Intestine with a caecum.

Ocellus situated much nearer to eye than to apex of rostrum. Length 0.6 mm.

Male. Rostrum shorter than in the female. Postabdomen scarcely tapering distally. Only the distal anal denticles are visible; proximal to them are small setae up to the anus. Claws with setae on the concave margin and with 2 basal denticles, the distal denticle larger. Vas deferens opening at base of claws, ventral to them. Length 0.36 mm.

Distribution. France, England, North and South America, Africa, East China. Not found so far in the USSR.

6. **Pleuroxus toumodensis** Brehm, 1934 (Figure 223)

Brehm, 1934a:70–71, Figures 20–23.

Material. Several females from the White Nile.

Female. Posteroventral corner of valve with 3 denticles. Valve with undulate posterior margin. Valve with lines, 10 of these lines at the posterior margin. Rostrum pointed.

233 Antennules ending at distance of more than their own length before apex of rostrum. Postabdomen tapering but with wide distal end. Preanal corner blunt. Anal denticles thin, in group. Lateral setae about ocellus situated nearer to eye than to apex of rostrum.

Male. Unknown.

Distribution. Lower reaches of the Niger, the White Nile.

7. Pleuroxus laevis Sars, 1862

Female. Dorsal margin strongly convex. Ventral margin of valve only slightly convex. Maximum height of body slightly before middle of body. Posterodorsal corner of valves distinct, slightly projecting. Posteroventral corner of valves rounded, with a denticle. Behind the denticle, the posteroventral corner bears a row of small setae near the margin on the inner side of the posterior margin. Posterior margin of valve almost straight, shorter than the maximum height by a factor of 2.3. Margin of head shield continuing smoothly into dorsal side of valves. Rostrum long, directed posteroventrally. Head shield with rounded posterior margin (Frey, 1959, 1962a). Head pores typical of the subfamily. Valve with indistinct lines at the anterior margin. Antennules ending slightly before middle of rostrum. Anterior margin of antennules with a sensory seta on the distal end. Esthetascs situated on distal end, similar in length.

Antennae not reaching apex of rostrum or end of antennules. Setae on antennae: 0–0–3/1–1–3. Plate of labrum with convex anterior margin and produced apex.

Ratio of length to width of postabdomen more than 3. Postabdomen tapering distally. Width of distal end of postabdomen only slightly more than twice basal width of claws. Preanal corner pointed. Distal dorsal corner with 2 rows of 17–18 anal denticles. Distal margin of anus with a row of fine setae. Dorsal margin of postabdomen slightly undulate; anal denticles irregularly distributed. The distal anal denticle is not always the largest. Several distal denticles isolated and sometimes much larger than the others. Claws with setae on the concave margin, with 2 basal spines, the distal spine being the longer. Ventral side of postabdomen with incisions with setae. Intestine forming a double loop. Ocellus situated nearer to eye than to apex of rostrum. Legs 5 pairs, typical of the genus. Length up to 0.65 mm.

Male. Dorsal and ventral margin strongly convex, posterior margin straight. Maximum height before middle of body. Head shield passing smoothly into dorsal margin of valves. Posterodorsal corner of valve distinct. Valves with a denticle at the posteroventral corner. Valves with pattern of longitudinal polygons and fine dots. Entire ventral margin of valve with setae; a row of small setae near the margin on inner side of posterior margin. Rostrum pointed. Antennules more than half the length of the rostrum, ending slightly less than their own length from apex of rostrum. Distal part of anterior margin of antennule with a flagellum and a sensory seta. Postabdomen tapering distally. Preanal corner projecting. Claws with 2 basal spines. Vas deferens opening dorsal to base of claws. Antennules, eye, and ocellus relatively larger than in the female. Length 0.5 mm.

Key to Subspecies of P. laevis according to Females

1 (4). Dorsal margin of postabdomen not distinctly undulate.
2 (3). Valve with lines in anterior part . . . 7a. P. laevis laevis Sars, 1862.

3 (2). Valve without pattern. . .7b. **P. laevis incertus** Brehm, 1934, comb. n.
4 (1). Dorsal margin of postabdomen distinctly undulate . . . .
. . . . 7c. **P. laevis pithyusus** Schiklejew, 1929, comb. n.

7a. Pleuroxus laevis laevis Sars, 1862 (Figures 224–228)

Sars, 1862a:164–165 (laevis); 300 (hastatus); Norman and Brady, 1867:389–391, Plate XVIII, Figure 5, Plate XXI, Figure 14 (Lynceus laevis); P.E. Müller, 1867:193, Plate III, Figure 25, Plate IV, Figures 18, 19 (hastatus); Sars, 1891:48 (Peracantha); Birge, 1893:306–307, Plate XIII, Figure 11 (hastatus); Lilljeborg, 1900:528–531, Plate LXXIII, Figures 21–22, Plate LXXIV, Figures 1–5 (laevis); Brady, 1906:182, Plate XXXII, Figures 9, 10 (assimilis); Delachaux, 1917:88–89, Figures 15, 16; Shikleev, 1929:33–34, Figures 27–28 (P. insigniter syn. n. – apparently described after a specimen with a deformity of the postabdomen which we also found in P. laevis laevis – Figure 85, as did Berg (1929–1930)); Bening, 1941; 277–278, Figure 114 (laevis); Frey, 1959:39, Figure 55; 1962a, Figure 55 (laevis); Šrámek-Hušek et al., 1962:370–372, Figure 139 (laevis); Herbst, 1962:96, Figure 79 (laevis); Chiang Sieh-chih, 1964:84–85, Figures 29–31 (sinkiangensis syn. n.); Negrea, 1966a:147 (laevis); Smirnov, 1966c; Figures 5, 21 (laevis).

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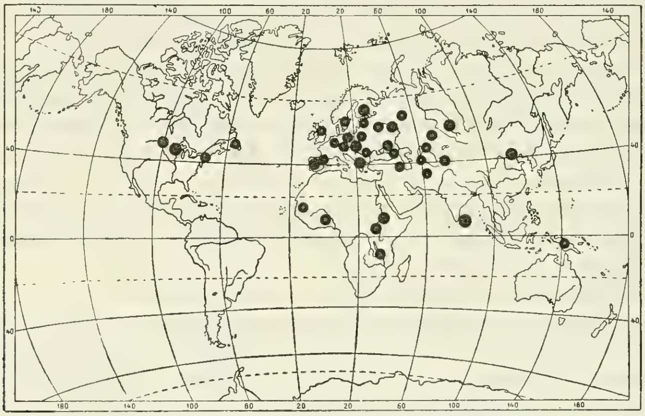

FIGURE 224. Distribution of Pleuroxus laevis

Material. Numerous females from the Cherepovets, Ivan'kovo, and
234 Rybinsk reservoirs from the rivers Il'd and Sutka, tributaries of the Rybinsk Reservoir, and from the delta of the Terek River. Several females from lakes in the Aktyubinsk Region. One male from the Cherepovets Reservoir. Preparations: MGU – female 395, deformed females 966, 734, 588, male 389. ZIN – female 1921. Ph – female 1730.

Female. Dorsal margin of postabdomen slightly concave, not undulate. Valves with lines in anterior part and with indistinct pattern of polygons.

Distribution. Holarctic Region, Africa, Ceylon, European USSR to the Ob' River in the East.

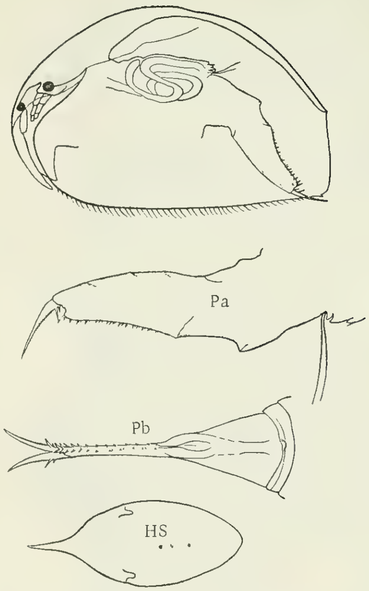

FIGURE 225. Pleuroxus laevis laevis, female, length 0.53 mm (Rybinsk Reservoir, 14 August 1962):

Pa — lateral view (Rybinsk Reservoir, 15 August 1962); Pb — dorsal view (Shumorovka River, 2 August 1962); HS — after Frey, 1962a.

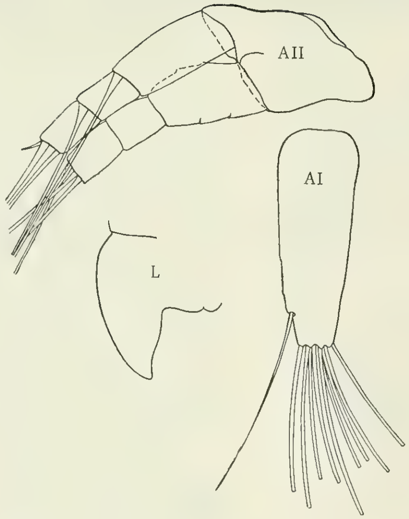

FIGURE 226. Pleuroxus laevis laevis, female:

AII — Shumorovka River, 2 August 1962; L — Rybinsk Reservoir, 15 August 1962; AI — Yaroslavl Region.

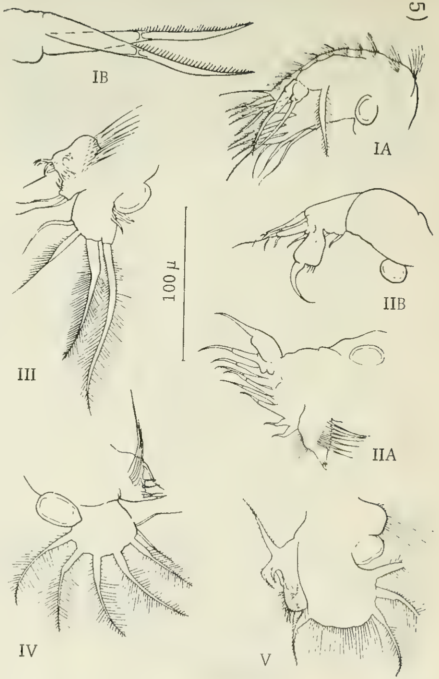

FIGURE 227. Legs of female of Pleuroxus laevis laevis (Shumorovka River, 2 August 1962): IA, IIA — left legs, outer view; IB — outer ramus of endite; IIB — left leg, ventral view; III — left leg; IV — right leg, outer view; V — right leg, inner view.

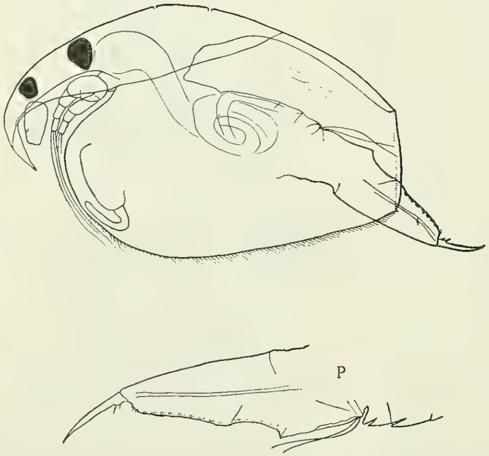

FIGURE 228. Pleuroxus laevis laevis, male, length 0.43 mm (Cherepovets Reservoir, Goritsy, 21 October 1963, preparation 389)

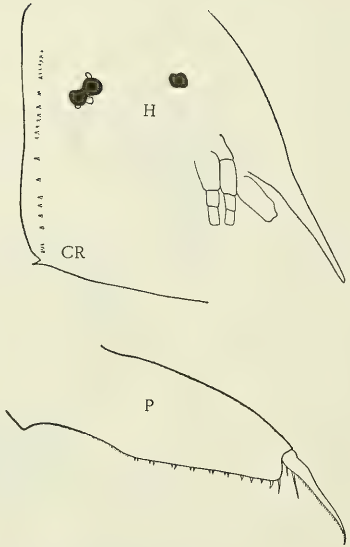

FIGURE 229. Pleuroxus laevis incertus, female (after Brehm, 1934a)

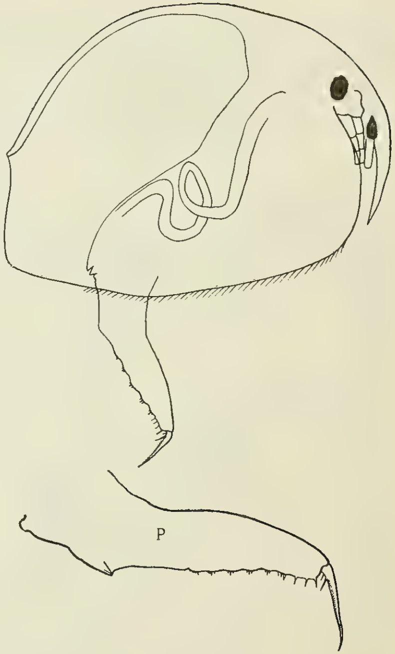

FIGURE 230. Pleuroxus laevis pithyusus, female, length 0.5 mm (Gagra, after lectotype, preparation 922)

7b. **Pleuroxus laevis incertus** Brehm, 1934 comb. n.
(Figure 229)

Brehm, 1934a:67–69, Figures 14, 15, 16 (incertus).

Material. Data from the literature given.

Female. Posterior margin of valves with spinules on inner side. Valves without pattern. Ocellus half the size of the eye.

Distribution. Niger River.

7c. **Pleuroxus laevis pithyusus** Schiklejew, 1929, comb. n.
(Figure 230)

Shikleev, 1929:32–33, Figures 24, 25, 26 (pithyusis); 1930b: 347, Figures 21, 22 (pithyusus).

Material. One female from Gagra (preparation of Shikleev). Lectotype: MGU – female, marked with India ink in preparation of Shikleev, preparation 922.

Female. Posteroventral corner of valve with 1–2 denticles. Valve with indistinct longitudinal lines. Postabdomen with undulate dorsal margin. Anal spinules: 3 distal isolated spinules, then 4 groups of 3 spinules, a group of 4 spinules, and a group of 5 spinules. The largest spinule in groups 2–5 is the second (distal spinule counted as first). Claws with setae on the concave side. Length 0.5 mm.

Distribution. Northern Caucasus.

8. **Pleuroxus striatus** Schoedler, 1858 (Figures 231–236)

Schoedler, 1858:28; 1862:25, Plate II, Figure 37; 1863:48, Plate 2, Figure 37; Hudendorff, 1876:57–58, Plate II, Figure 8a, b (gracilis); Birge, 1879:21–22, Plate I, Figure 22 (unidens); Herrick, 1884:111–112, Plate F, Figure 15 (unidens); Lilljeborg, 1900:531–534, Plate LXXIV, Figures 6–12; Uéno, 1937:207, Figure 7; Bening, 1941:279–280, Figure 115; Frey, 1959:39, Figure 52; 1962a, Figure 52; Šrámek-Hušek et al., 1962:372–374, Figure 140A–E; Herbst, 1962:96–98, Figure 80; Chiang Sieh-chih, 1964: 84; Smirnov, 1964:305–318; 1966c: Figures 6, 13, 14, 22.

Material. Numerous females from Rybinsk Reservoir and Il'd River. One male from Rybinsk Reservoir. Preparations: MGU – females 1891, 1075, 367, 1891, male 1892. ZIN – female 383. Ph – female 1635.

Female. Dorsal and ventral margin convex. Posterior margin of valve straight, shorter than maximum height by a factor of 2.4. Posteroventral corner of valve rounded, with a denticle. There may be 2 denticles or none. Head shield passing smoothly into dorsal margin of valve. Maximum height in the middle. Rostrum long, directed posteroventrally. 238 Valves with longitudinal lines, 14–18 such lines on the posterior margin. Lines fused at some points. Intervals between lines smooth. Head shield with rounded posterior margin. Head pores typical of the subfamily.

Antennules less than half length of rostrum. Sensory seta of antennules situated distal to middle of anterior margin. Esthetascs situated on distal

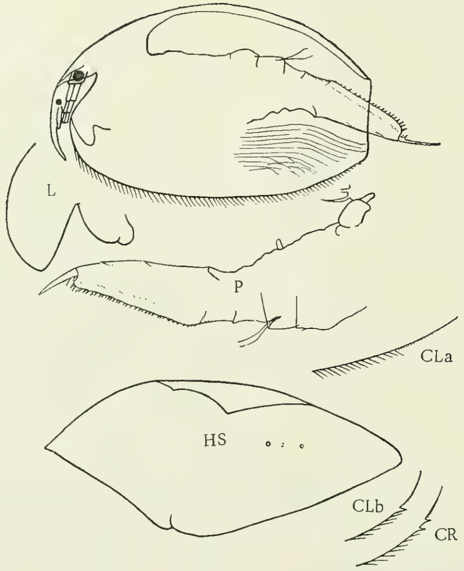

FIGURE 231. Pleuroxus striatus, female, length 0.74 mm (Il'd River, 10 August 1962):

L – Il'd River, 10 August 1962, preparation 1075;
CLa – Il'd River, 10 August 1962, preparation 367;
CLb, CR – Rybinsk Reservoir, Borok, 13 September 1965, preparation 1891; HS – head shield of exuviae of 5th stage, length 450 μ.

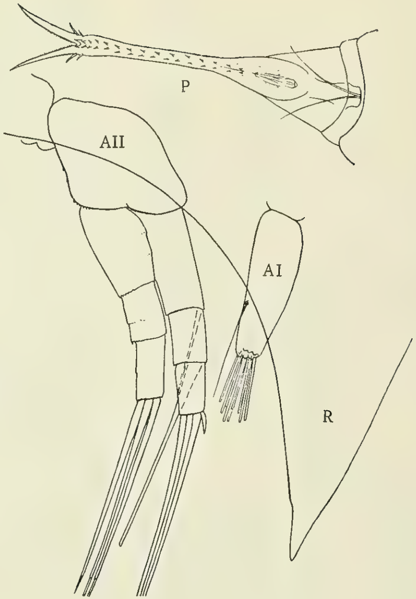

FIGURE 232. Pleuroxus striatus, female (Il'd River, 10 August 1962)

end, of slightly different length. Antennules ending at more than their own length from apex of rostrum. Antennae not reaching apex of rostrum. Setae on antennae: 0–0–3/1–1–3. Segments of antennae with spine-shaped incisions. Plate of labrum with convex anterior margin and blunt apex.

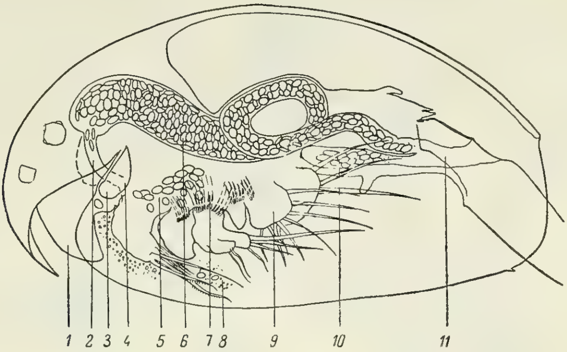

FIGURE 233. Pleuroxus striatus, female. Intestine and arrangement of legs (Il'd River, 10 August 1962, preparation 383):

1 – plate of labrum; 2 – esophagus; 3 – mandible; 4 – mouth; 5 – diatoms before mouth; 6 – mid-intestine filled with diatoms (mainly Cocconeis); 7 – filtration chamber; 8 – food scraped up from substrate; 9 – pumping chamber; 10 – caecum; 11 – hind intestine.

Postabdomen long, its distal margin more than double width of base of claws. About 20 anal denticles, passing into a row of setae at the anus. Lateral setae present. Preanal corner not projecting. Ventral margin having incisions with setae. Claws with setae on the concave margin and with 2 basal spines. Ocellus situated nearer to eye than to apex of rostrum. Six pairs of legs. Leg I with rows of setae on the anterior margin; outer ramus of endite with 2 large brushlike setae and one hook-shaped seta which is about half as long. Leg VI situated some distance from leg V and forming a small lobe which is distinct in live specimens. Other legs typical of the genus. Length up to 0.8 mm.

Male. Posterodorsal and posteroventral corner of valve rounded. Antennules almost reaching apex of rostrum. Antennule with 2-segmented flagellum proximal to middle of anterior margin and with a distal sensory seta. Postabdomen with a row of 12–13 anal denticles, passing into a row of setae. Preanal corner not differentiated. Vas deferens opening dorsal to base of claws. Length up to 0. 54 mm.

Distribution. Holarctic Region, Africa, European USSR, Maritime Territory.

9. **Pleuroxus hamatus** Birge, 1879

Female. Valves with distinct posterodorsal corner. Posteroventral corner of valves rounded, without denticles. Valves with lines. According

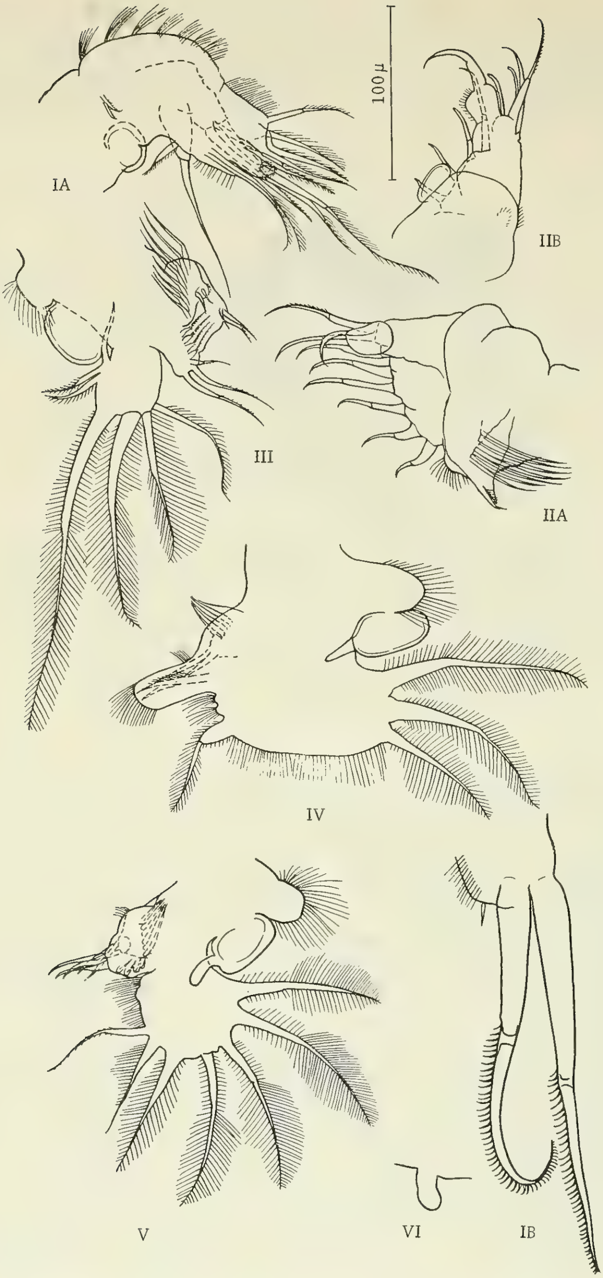

FIGURE 234. Legs of female of Pleuroxus striatus, left side (Il'd River, 10 August 1962):

IA, III — inner view; IB — outer ramus of endite; IIA, IV, V, VI — outer view; IIB — ventral view.

to Brooks (1959) the valve is reticulate and has cells with longitudinal striation. Rostrum long, pointed. Antennae with a seta on basal segment of exopodite; this seta is slightly longer than total length of the three segments of the exopodite (Frey, 1961b). Antennules ending at more than their own length before apex of rostrum. Plate of labrum with pointed apex.

Postabdomen widest in the middle. There are 12–14 anal denticles. Preanal corner differentiated. Claws with 2 basal spines, the distal spine longer. Exopodite of leg I with 2 setae, one of them long, the other very
241 short. Outer ramus of endite of leg I with 3 setae (2 long, 1 short); one of the long setae thin, the other in the form of a thick hook. Intestine forming loops. Ocellus situated nearer to eye than to apex of rostrum. Length 0.6 mm.

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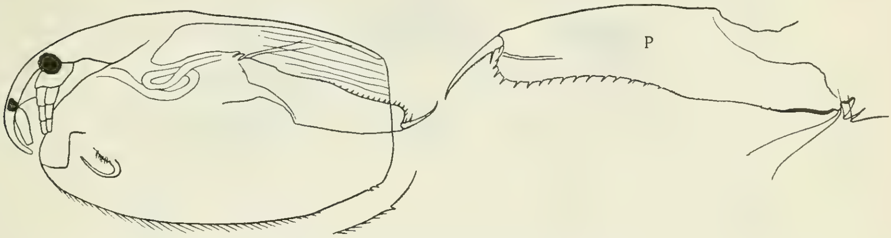

FIGURE 235. Pleuroxus striatus, male, length 0.53 mm (Rybinsk Reservoir, 13 September 1965, preparation 1892)

Male. According to Kiser (1950) ventral margin of valve slightly concave in posterior half. Maximum height in the anterior half. Posteroventral corner of valves rounded, without denticles. Valves with longitudinal lines. Rostrum pointed, curved posteriorly. Antennules thicker than in female. Esthetascs short. Antennules with a seta on the anterior side. Postabdomen tapering distally. There are 10–12 postanal setae, the largest of them at base of claws. Preanal corner not distinct. Claws with 2 basal denticles. Length 0. 36 mm.

Key to Subspecies of P. hamatus according to Females

1 (2). Valve with more than 6 longitudinal lines. Striation between lines present. . . . . 9a. **P. hamatus hamatus** Birge, 1879.
2 (1). Valve with at most 6 longitudinal lines. Striation and undulate lines between the lines . . . . 9b. **P. hamatus vulcanicus** Brehm, 1951.

9a. **Pleuroxus hamatus hamatus** Birge, 1879
(Figures 236–239)

Birge, 1879:22–23, Plate II, Figures 13, 14 (hamatus); Herrick, 1884: 110–111, Plate H, Figure 1; Birge, 1910 (hamulatus); Brehm, 1934a:69–70, Figures 17, 18, 19 (chappuisi); 1937:507–509, Figure 4 chappuisi.

The author agrees with Frey (personal communication) on the synonymy of this species); Šrámek-Hušek, 1946; 232–240, Figure 1, b–g, Figure 2, a–c (striatoides); Harding, 1957b:82–83, Figures 43–46 (chappuisi); Šrámek-Hušek, 1962:374–375, Figure 140, F–L (chappuisi); Chiang Sieh-chin, 1964:83, Figures 26–28 (hamulatus).

Material. Five females from Western Sudan (Gebel Marra). Preparations: MGU – female 2283. ZIN– female.

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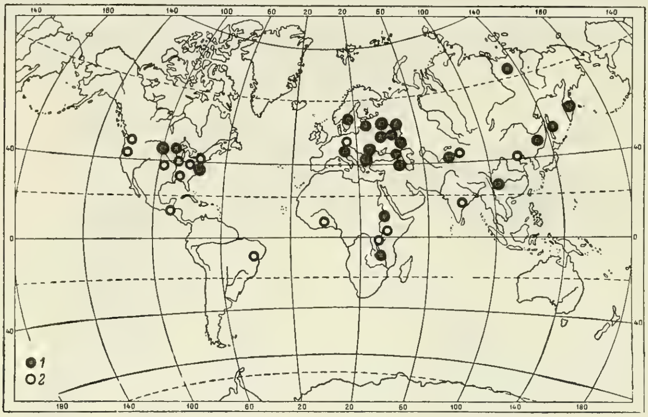

FIGURE 236. Distribution:

1 – Pleuroxus striatus; 2 – P. hamatus hamatus.

Female. Valve with more than 6 longitudinal lines. Short undulate lines between longitudinal lines absent. Setae on antennae: 0–0–3/1–1–3.

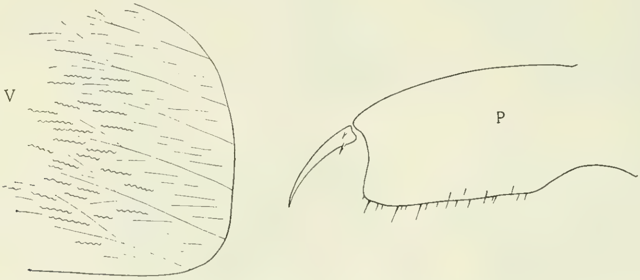

FIGURE 237. Pleuroxus hamatus vulcanicus (after Brehm, 1951a)

Distribution. Europe, North and South America, India, Africa, northeast China. Not found in the USSR.

9b. **Pleuroxus hamatus vulcanicus** Brehm, 1951 (Figure 237)

Brehm, 1951b:260–261, Figures 1, 2, 3 (ssp. vulcanica).

Female. Length of antennules double the width. Sensory seta situated in middle of antennule. Valve with 5 longitudinal lines, with striation and

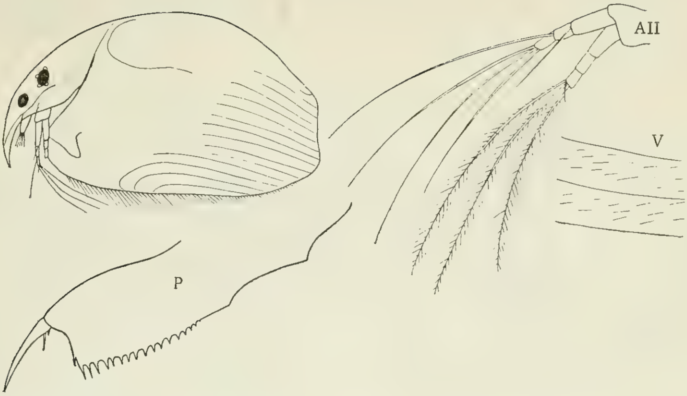

FIGURE 238. Pleuroxus hamatus hamatus, male, left side: AII, V – after Šrámek-Hušek et al., 1962; P – after Brehm, 1934a.

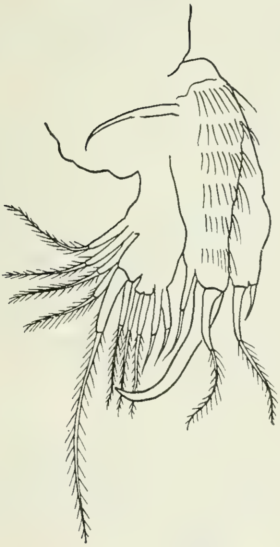

FIGURE 239. Leg I of female of Pleuroxus hamatus hamatus (after Brooks, 1959)

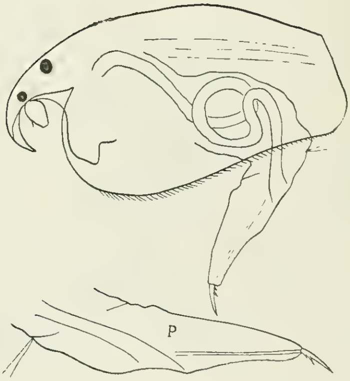

FIGURE 240. Pleuroxus hamatus hamatus, male (after Kiser, 1950)

undulate lines between them. Postabdomen with more than 10 anal denticles, single or in groups. Lateral setae absent. According to Brehm (1951b), outer lobe of endite of leg I with 3 setae, 2 of them forked (Figure 112).

Distribution. Cameroon.

10. **Pleuroxus uncinatus** Baird, 1850 (Figures 209, 241–246)

Baird, 1850:135, Plate XVII, Figure 4; Leydig, 1860:227, Plate IX,
Figure 70 (Lynceus personatus); 228 (L. uncinatus); Schoedler,
1862:26 (glaber); 1863:55–56, Plate III, Figures 54–56 (Rhypophilus
glaber); 56 (Rh. personatus); Norman and Brady, 1867:42, Plate
XVIII, Figure 9, Plate XXI, Figure 13 (Lynceus); P.E. Müller, 1867:191,
Plate III, Figure 26, Plate IV, Figures 21–23 (personatus); Kurz, 1874:69
(glaber); Daday, 1885a:182 (balatonicus); 1885b:162–163 (balatonicus);
1885c:162 (balatonicus); 1888:93, Plate I, Figures 42–44
247 (uncinatus). (Pleuroxus balatonicus was apparently described
from a population of P. uncinatus in which the transition from juvenile
males to adults was delayed by the conditions in Lake Balaton; hence the
abundance of juvenile males); Matile, 1890:54–56, Figures 46, 46a (personatus);
Sars, 1891:48 (var. deflexa); Lilljeborg, 1900:537–541,
Plate LXXV, Figures 1–10; Langhans, 1911:46–47 (bairdi syn. n.);
Bening, 1941:283–284, Figure 117; Sebestyén, 1947:11–12, Figures 1–18
(balatonicus); Frey, 1959:40, Figures 56, 57; 1962a, Figures 56, 57;
Šrámek-Hušek et al., 1962:378–381, Figure 142; Herbst, 1962:98, Figure 83;
Frey, 1965c:106a–113, Plates I, II, III (var. balatonicus); Negrea, 1966a:
148; Smirnov, 1966c, Figures 9, 26, 27 (uncinatus, convexus).

Material. Numerous females from the Uglich, Rybinsk, and Kama reservoirs, and from the Il'd River. Several females from ponds in the Yakot' fish farm. Three specimens from the Pechora River (Komi ASSR). Several males from the Rybinsk Reservoir. Preparations: MGU – females 1419, 384, 1416, 342, 1422, 1421, 1373, 1294, 1374, 1373, 745, 387, 760, males 981, 1895, juvenile male 39. ZIN – female 1425, male 688. Ph – female 430.

Female. Dorsal margin strongly convex. Posterior margin about $^{1}/_{3}$ maximum height of body. Posteroventral margin of valve with 0–6 denticles. Number of denticles largest in small specimens. Valve with pattern of pentagonal-hexagonal cells. Rostrum long, directed ventrally, its apex curved more or less anteriorly.

Head shield with pointed posterior margin (Frey, 1959, 1962a). Head pores typical of the subfamily. Examination from in front shows the irregular lateral outline and the great width. Antennules reaching to middle of rostrum. Anterior margin of antennules with a sensory seta situated slightly distal to the middle. Setae on antennae: 0–0–3/1–1–3, spines 1–0–1/0–0–1. Segments of antennae with spine-shaped incisions. Antennae not reaching apex of antennules. Plate of labrum with strongly convex anterior margin and slightly pointed apex.

Postabdomen with blunt preanal corner. Anus with concave margin. About 13 anal denticles. Claws with a row of setae on the concave margin and 2 basal spines. Intestine forming loops. Ocellus slightly smaller than eye. Legs typical for the genus. Outer ramus of endite of leg I with

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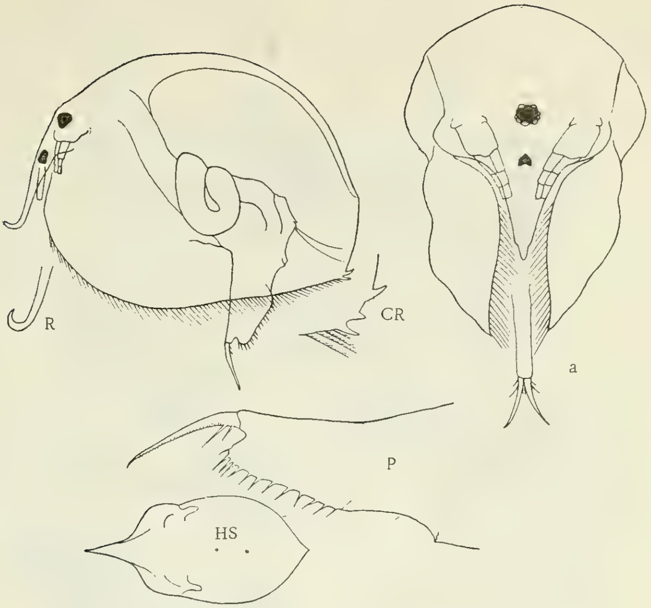

FIGURE 241. Pleuroxus uncinatus, female, left side, length 0.62 mm (Il'd River, 10 August 1962):

R — Pechora River, Lebyazhskaya Kur'ya, 4 August 1963, preparation 1373; HS — after Frey, 1962a; a — anterior view, Il'd River, 10 August.

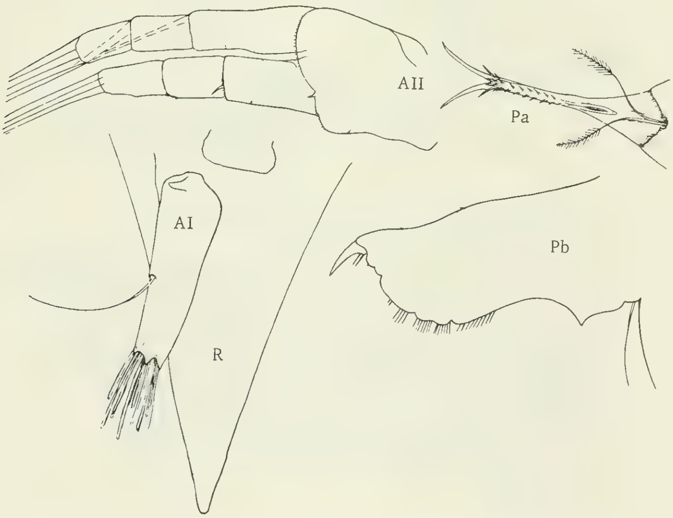

FIGURE 242. Pleuroxus uncinatus (Il'd River, 10 August 1962):

AII — right antenna of female; AI — antennule of female and apex of rostrum; Pa — postabdomen, dorsal view; Pb — postabdomen of female with embryos, with characters of hermaphroditism (after Grochowski, 1896).

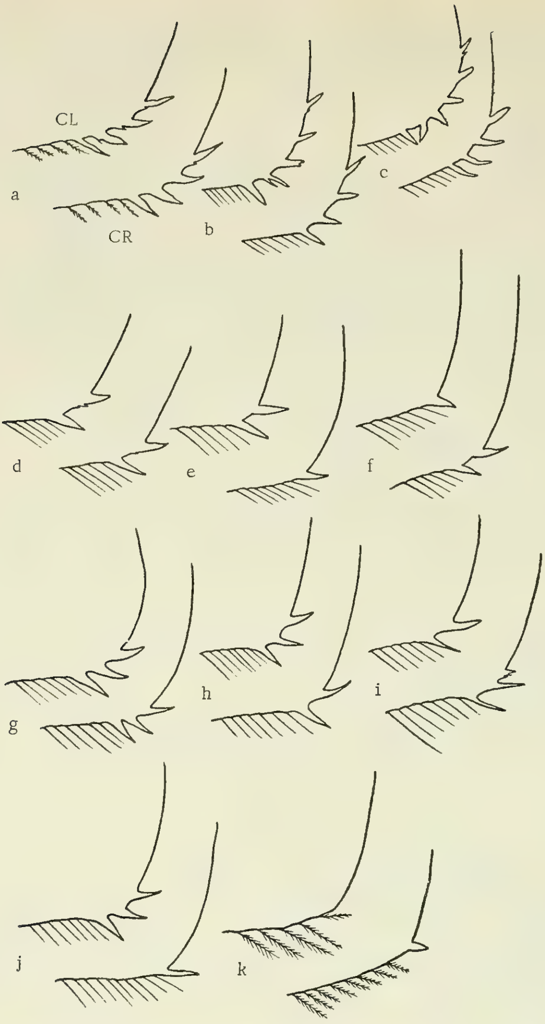

FIGURE 243. Denticles on posteroventral corner of valves of female of Pleuroxus uncinatus:

a — Pechora River near Lemtybozh, 1 August 1963, preparation 1294; b — Pechora River, Lebyazhskaya Kur'ya, 4 August 1963, preparation 1374; c — same locality, preparation 1373; d — Il'd River, 10 August 1962, preparation 745; e — same locality, preparation 387; f — same locality, preparation 760; g — Rybinsk Reservoir, Borok, 25 July 1964, preparation 1421; h — Il'd River, 10 August 1962, preparation 742; i — Rybinsk Reservoir, Borok, 25 July 1964, preparation 1422; j — same locality, preparation 1416; k — Il'd River, 10 August 1962, preparation 384.

(245)

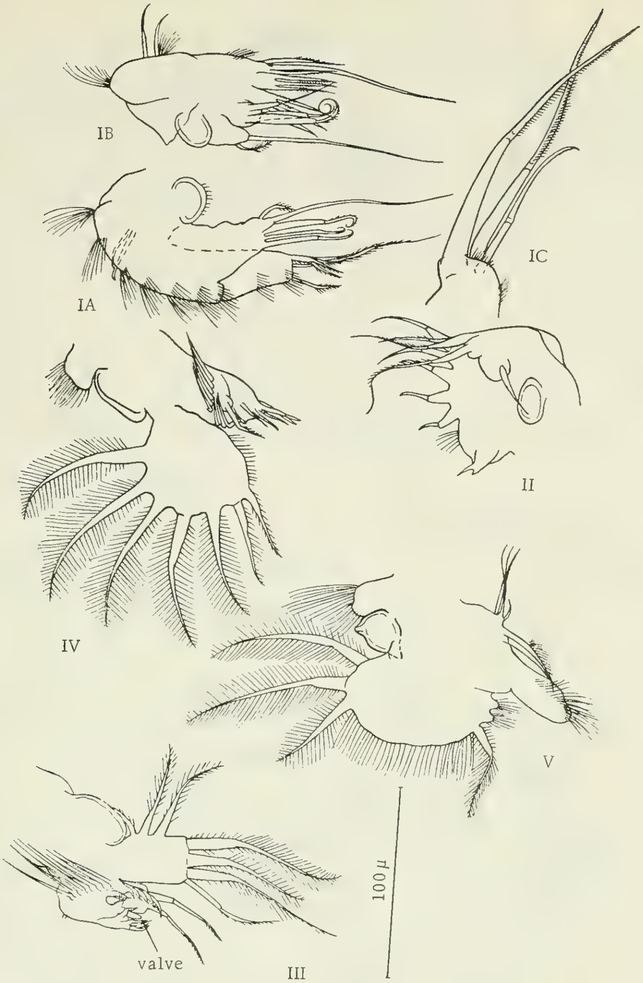

FIGURE 244. Legs of female of Pleuroxus uncinatus (Il'd River, 10 August 1962):

IA, II, III – left legs, outer view; IB – left leg, anterior view; IC – outer ramus of endite; IV, V – left legs, inner view.

(246)

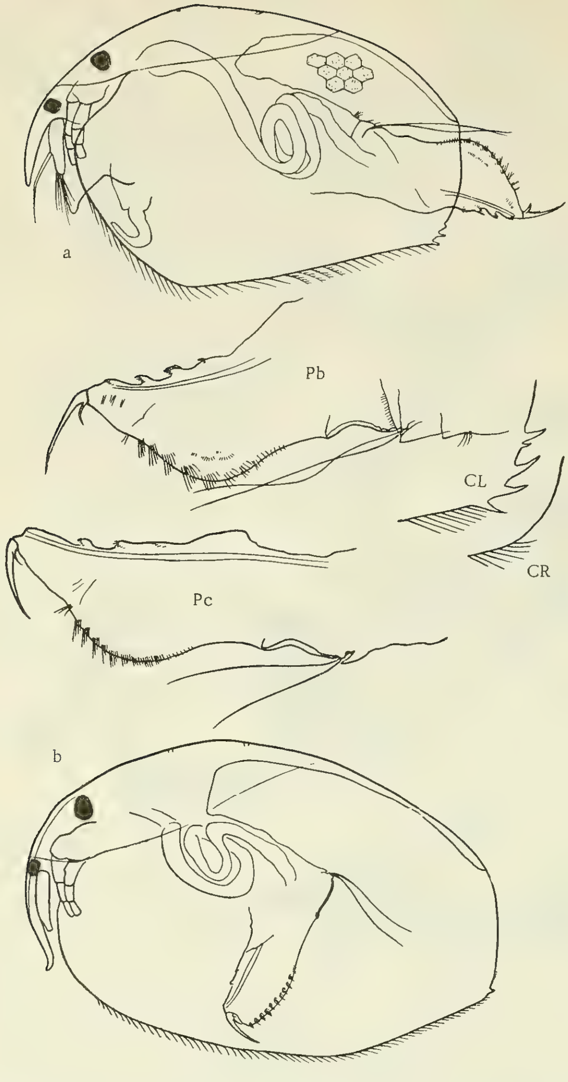

FIGURE 245. Pleuroxus uncinatus:

a — male, length 0.50 mm (Rybinsk Reservoir, Borok, 30 September 1963, preparation 688); Pb — postabdomen; Pc — postabdomen of another male, 30 September 1965, preparation 1895; CL — 30 September 1965, preparation 981; b — juvenile male, length 0.47 mm, 14 October 1964, preparation 39.

brushlike setae of about equal length. Hook-shaped seta slightly more than half length of the brushlike setae. Length up to 0.65 mm.

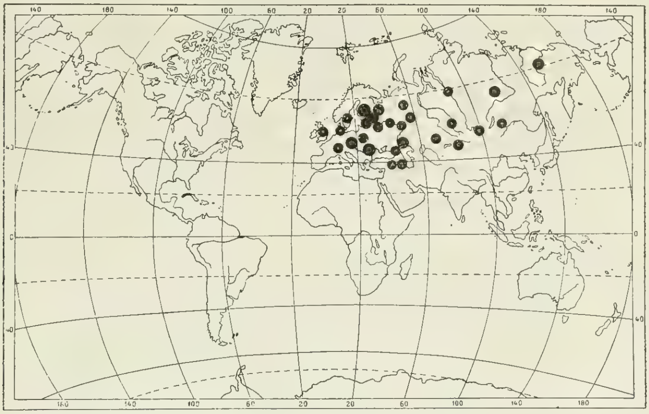

FIGURE 246. Distribution of Pleuroxus uncinatus

Male. Ventral margin of valves strongly convex in the middle. Posterior margin of valves shorter than maximum height by a factor of about 2.5. Posteroventral corner of valve denticulate, sometimes without denticles. Valve with a pattern of hexagons and small dots in them. Rostrum short. Antennules almost reaching apex of rostrum. Antennules with a sensory seta in middle of anterior margin and more distally, a 2-segmented flagellum. Distal segments of antennae not reaching distal end of antennules. Postabdomen strongly convex in middle of dorsal margin; distal part of postabdomen tapering toward base of claws. Groups of anal setae on dorsal margin from the anus not reaching base of claws. Claws with a single basal spine. Ventral side of postabdomen with incisions with setae which usually form tubercles. The form of the tubercles varies.
248 Vas deferens opening ventral to base of claws. Ocellus situated halfway between eye and apex of rostrum. Length to 0.56 mm.

Juvenile male. Leg I with a hook. Antennules ending far before apex of rostrum. Postabdomen resembling that of the female, but without anal denticles. Lateral groups of setae present. Claws with two basal spines. Vas deferens opening ventral to base of claws.

Pleuroxus (Rhypophilus) convexus Poggenpol' (1874) is probably a juvenile form of this species. These males are up to 0.50 mm long.

Distribution. Palearctic. Ubiquitous in the USSR.

Biology. Lives on bare bottom.

11. Pleuroxus truncatus (O. F. Müller, 1785)

Female. Dorsal margin more strongly convex than ventral margin. Maximum height before middle. Height of posterior margin about $\frac{1}{3}$ maximum height. Entire posterior margin with 11 to 20 denticles. Anterior margin of valve denticulate. Valve with longitudinal lines. Head pores typical for the subfamily. Rostrum pointed. Antennules not reaching to apex of rostrum. Distal segments of antennae reaching apex of antennules. Setae on antennae: 0–0–3/1–1–3. Antennae with spines on proximal segment of exopodite and on both distal segments. Plate of labrum with convex anterior margin; apex of labrum pointed but not produced.

Dorsal margin of postabdomen straight with an incision near the anus and with 11–20 anal denticles which decrease in size proximally. Distal part of anal incision with a row of small setae. Postabdomen with groups of short setae laterally; ventral margin of postabdomen with incisions with spinules. Claws with two basal denticles. Distal basal denticle almost as long as basal width of claw. Convex and concave side of claws with setae. Ocellus situated nearer to eye than apex of rostrum. Our illustrations correct those of the legs of the female published by Lilljeborg (1900) in the following details: exopodite of leg III with 7 setae, exopodite of leg V with two ear-shaped processes above seta 3 instead of a single process. A distinctive character of this species is the presence of a large hook-shaped seta on the outer ramus of the endite of leg I. The structure of the endites and gnathobases of legs III, IV, and V is shown in Figures 42, 47, and 48. Endite of leg III with hard setae in two groups, one of them consisting of setae 6, 7, and 8 (seta 6 short), the other group consists of setae 1–5 (short and hook-shaped). A thin spiniform seta present between these groups. Endite with 7 soft setae. Filtering fan of gnathobase of leg III with 8 setae. Endite of leg IV with 4 hard setae of about equal length. Endite with 4 soft setae. Filtering fan of gnathobase with 5 setae. Large seta on apex of gnathobase curved in the same direction as the hard setae of the endite and slightly longer than these. Leg V has lobed endite with 2 setae. Filtering fan of gnathobase with 3 setae. Ocellus smaller than eye. Length from 0.48 to 0.65 mm according to material from the Gorki Reservoir (1 August 1960), minimum length of gravid specimens 0.49 mm (third stage).

Male. Dorsal margin of body uniformly sloping toward posterodorsal corner. Valve with strongly convex ventral margin. Posterior margin shorter than maximum height by a factor of 2.3, denticulate its entire length. Anterior margin of valve with denticles. Valves with lines. Rostrum short. Antennules projecting far beyond apex of rostrum. Antennules with 2 sensory setae in middle of anterior margin. Distal segments of antennae not reaching apex of antennules. Setae in antennae: 0–0–3/1–1–3. Postabdomen resembling that of female but without anal denticles. Groups of lateral setae present. Anal margin straight. Preanal corner not projecting. Claws with setae on the convex margin and with 2 basal denticles.

Antennules, eye, and ocellus relatively larger than in female. Ocellus nearer to apex of rostrum than to eye. Legs as in the female, except leg I. Outer ramus of endite of leg I with a hook for attachment to the valve of the female and also with an accessory hook-shaped seta, 4 setae altogether. Length to 0.5 mm.

Biology. Lives in the vegetation. Monocyclic at vegetation periods of up to 8 months, dicyclic in longer vegetation periods (Vereshchagin, 1912c).

(249)

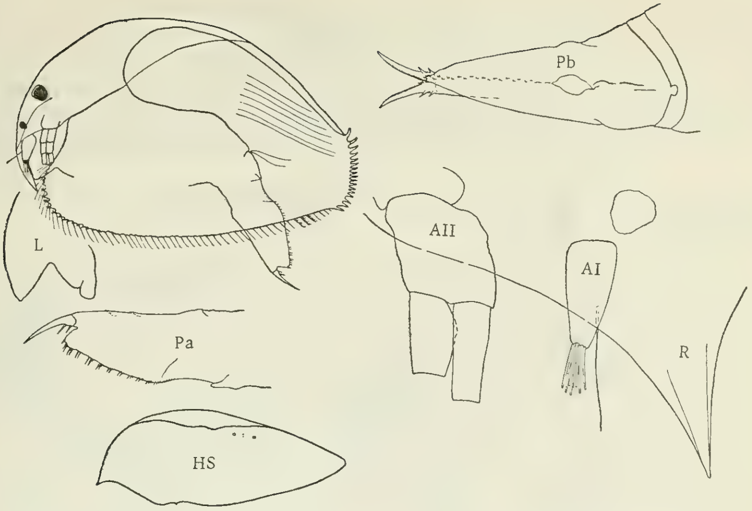

FIGURE 247. Pleuroxus truncatus truncatus, female, length 0.67 mm (Uglich Reservoir, 23 July 1962):

Pa — postabdomen; HS — head shield of 9th exuviae, inner view, length 500 μ; Pb — postabdomen, dorsal view (flattened by cover glass); L, Pb, R — Rybinsk Reservoir, 18 September 1962.

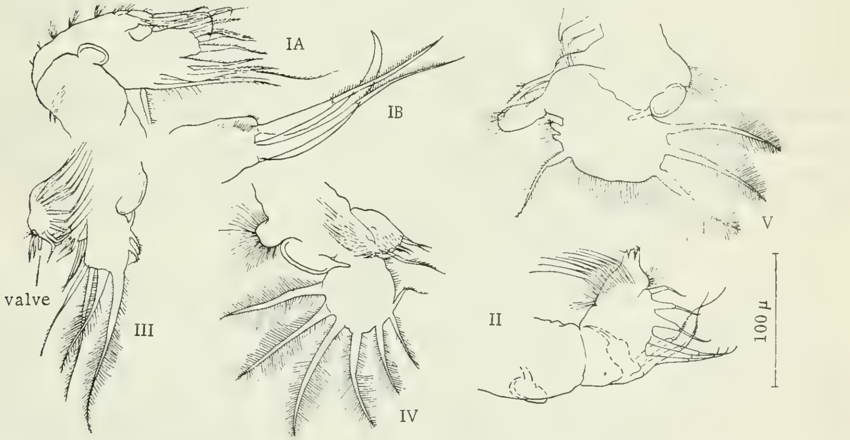

FIGURE 248. Legs of female of Pleuroxus truncatus truncatus, right side (Rybinsk Reservoir, 18 September 1962):

IA, IV — inner view; IB — outer ramus of endite; II, III, V — outer view.

Key to Subspecies of P. truncatus according to Females

1 (2). Antennules ending far before apex of rostrum . . . . 11a. **P. truncatus truncatus** (O. F. Müller, 1785).
2 (1). Antennules projecting distinctly beyond apex of rostrum . . . . 11b. **P. truncatus brevirostris** Schoedler, 1862.

250 11a. Pleuroxus truncatus truncatus (O. F. Müller, 1785)

(Figures 247–251)

O. F. Müller, 1785:75–76, Plate XI, Figures 4–5 (Lynceus truncatus); Linné, 1788:3008 (Monoculus); Baird, 1843:94–95, Plate III, Figure 15 (Peracantha truncata); Zaddach, 1844:29–30 (Lynceus); Baird, 1850:137, Plate XVI, Figure 1 (Peracantha truncata); Fischer, 1851: 190–191, Plate IX, Figures 7–11 (Lynceus truncatus); Leydig, 1860: 224–225 (L. truncatus); Schoedler, 1862:25, Plate II, Figures 29–30 (Peracantha truncata); 1863:40–41, Plate II, Figures 29, 30 (Peracantha truncata); P. E. Müller, 1867:188; Herrick, 1884:112 (truncatus); Klocke, 1892:188–189, Figures 1, 2 (var. Poppei, the name used by Klocke for forms with an angular dorsal profile behind the middle. This angle is situated at the border between head shield and valve and is found also in Chydorus gibbus (Flössner, 1962a). This character apparently varies with age and cannot be used for the establishment of a systematic taxon); Stingelin, 1895:258; Lilljeborg, 1900:522–527, Plate LXXIII, Figures 1–20 (Peracantha); Monard, 1918:351 (fuhrmanni); 1924: 16–17; Spandl, 1923b:346–351, Figures 1–6, I, II, III (Spandl cultured females with 12 denticles on the posterior margin of the valves and found that their progeny included females with 11–20 denticles. Some females had different numbers of denticles on the right and left valve: 12–14, 12–13, 14–12, 16–18. The species Peracantha fuhrmanni Monard, 1918, with 12–13 denticles on the posterior margin of the valves, can therefore not be accepted.) Wagler, 1937:60, Figure 243, 244, 245 (Peracantha); Uéno, 1937:206, 207, Figure 6 (Peracantha truncata); Bening, 1941: 266–268, Figure 110 (Peracantha truncata); Šrámek-Hušek et al., 1962:368–369, Figure 138 (Peracantha truncata); Herbst, 1962:96; Figure 78 (Peracantha truncata); Chiang Sieh-chih, 1964:85, Figure 32; Negrea 1966a:146–147 (Peracantha truncata); Smirnov, 1966c, Figures 10, 11, 13, 28, 29 (truncatus).

Material. Numerous females from the Volga reservoirs of Rybinsk, Cherepovets, Gorki, and Kuibyshev, from tributaries of the Rybinsk Reservoir, viz., the Il'd and Sutka rivers, from the Karelian Isthmus, the Komi ASSR, and lakes near Orenburg, Altai. One female from Lake Pikinskoe in the Perm Region, and one from a floodplain lake near the Amur. Numerous males from the Cherepovets and Rybinsk reservoirs and one from a pond near Omsk. Preparations: MGU – female 693, deformed females 1608, 714, 1674, male 1136. ZIN– female 700, male 1658. Ph – female 699.

Female. Antennules ending far before apex of rostrum. Ocellus situated nearer to eye than to apex of rostrum. The number of denticles on the posterior margin of the valves varies in different parts of the distribution, but the average numbers on the left and right valve are similar (Table 30).

Specimens with the same number of denticles on the left and right valve are much less numerous than those with a different number of denticles. No deformed specimens were found in the material examined. One female with 6 denticles on the posterior margin of the left valve was found in the Altai population. The posterior margin of the right valve of this specimen has 13 denticles; the denticles on the anterior margin of both valves are normal.

Distribution. Palearctic.

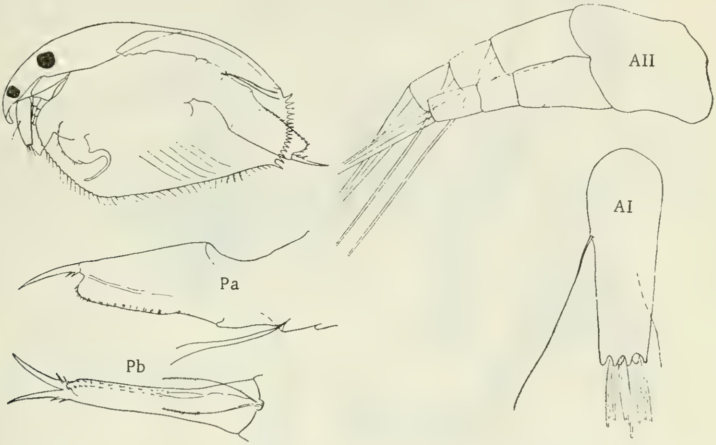

FIGURE 249. Pleuroxus truncatus truncatus, male, length 0.47 mm (Rybinsk Reservoir, 18 September 1962):

Pa – postabdomen; Pb – postabdomen, dorsal view.

252 TABLE 30. Number of teeth on posterior margin of valves of P. truncatus truncatus in different areas of its distribution

Locality	Number of specimens examined	Average number of denticles and limits of variation		Percentage of specimens with a different number of denticles
		left	right	
Pond in the Karelian Isthmus, 23 August 1954 ...	65	13.4 (11–16)	13.5 (11–16)	14
Rybinsk Reservoir, 13 September 1961	100	15.1 (12–18)	15.4 (10–19)	36
Kuibyshev Reservoir, 17 July 1961	100	15.0 (11–18)	15.0 (11–19)	20
Lake near Orenburg, 4 September 1963	100	15.6 (13–19)	15.6 (13–19)	25
Lake Lebedinoe, Altai Territory, 20 August 1967	8	14.9 (6–14–18)	15.1 (13–20)	13

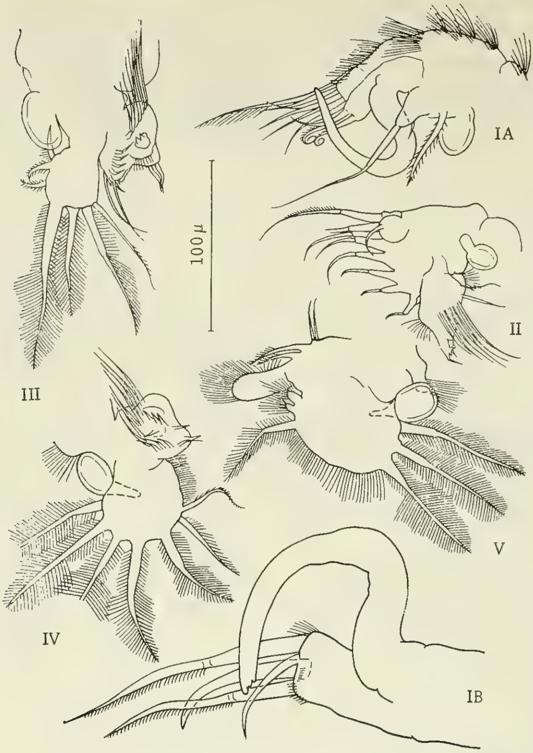

FIGURE 250. Legs of male of Pleuroxus truncatus truncatus (Rybinsk Reservoir, Borok, 18 September 1962):

IA, II – left legs, outer view; IB – outer ramus of endite; III, IV – left legs, inner view; V – right leg, inner view.

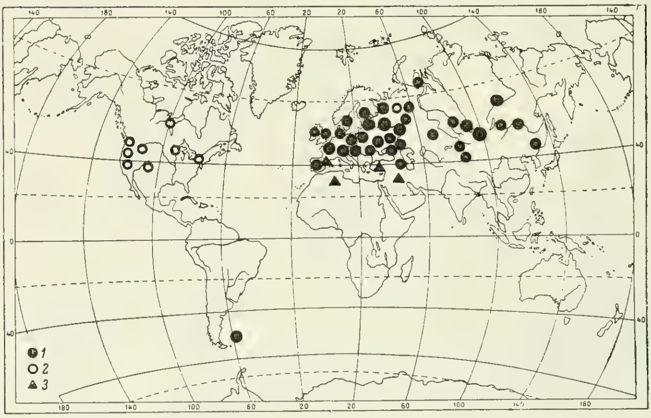

FIGURE 251. Distribution:

1 – Pleuroxus truncatus; 2 – P. procurvus; 3 – P. letourneuxi.

11b. **Pleuroxus truncatus brevirostris** Schoedler, 1862

Schoedler, 1862:25, Plate II, Figure 31 (Peracantha brevirostris); 1863:42, Plate II, Figure 31 (Peracantha brevirostris); Klocke, 1892:189 (var. brevirostris).

Material. According to description.

Female. Rostrum short, half length of antennules. Ocellus situated nearer to apex of rostrum than to eye. Such specimens, found by Schoedler, contained embryos in the brood chamber.

Distribution. Spree River (Berlin).

12. **Pleuroxus procurvus** Birge, 1879 (Figures 251–253)

Birge, 1879:16–18, Plate I, Figures 19–20; Herrick, 1882:250, Plate X, Figure 6; Birge, 1892 (procurvatus); Brehm, 1925a:286–288, Figures 1–3 (Nielseni); Brooks, 1959:645, Figures 27, 95; Frey, 1959:39, Figure 54; 1960:696, Figure 19; 1962a: Figure 54.

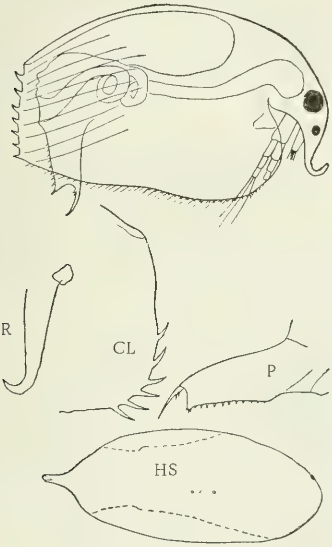

FIGURE 252. Pleuroxus procurvus, female, right side (after Herrick, 1882):

R, CL – Pechora River, 17 August 1958, preparation 2086, length 0.53 mm; P – after Kiser, 1950; HS – after Frey, 1962a.

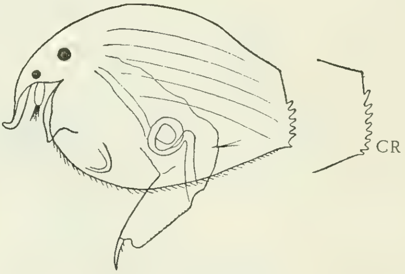

FIGURE 253. Pleuroxus procurvus, male (after Kiser, 1950)

Material. One female from the Pechora River. Preparation: MGU – female, 2086. One female from Little Sunapee Lake, New Hampshire, U.S.A. Preparation: MGU – female, 2516.

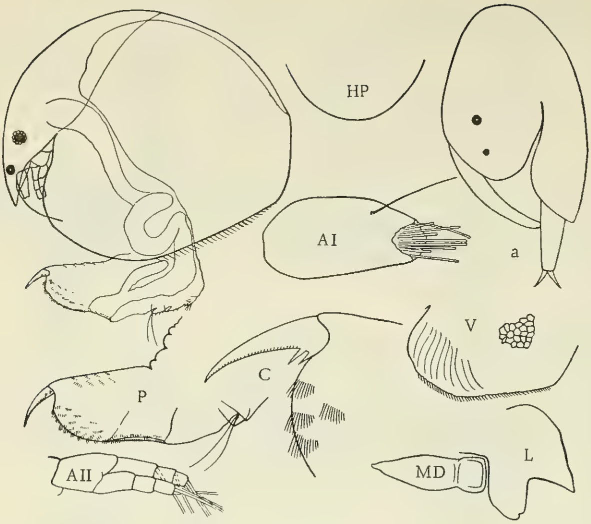

FIGURE 254. Pleuroxus letourneuxi, female:

a — anterior view; AI — right antennule, ventral view; AII — right antenna, ventral view.

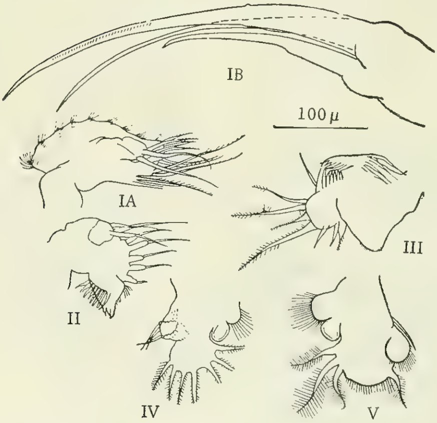

FIGURE 255. Right legs of Pleuroxus letourneuxi, female:

IA, II, V — outer view; IB — outer ramus of endite; III, IV — inner view.

Female: Posterior and anterior margin of valves denticulate. Posterodorsal corner well developed. Posteroventral corner of valve with a row of denticles which continues on posterior margin of valve. Three dorsal denticles directed dorsally, the others posteriorly; number of 254 denticles 6–8. Ventral margin of valve with feathered setae. Apex of rostrum curved anteriorly and dorsally. Head shield with rounded posterior margin. Head pores typical for the subfamily. Antennules ending some distance before apex of rostrum. Plate of labrum elongate, with rounded anterior margin and apex. Postabdomen with truncate distal margin. About 14 anal denticles. Claws with 2 basal spines. Ocellus nearer to eye than to apex of rostrum. Length up to 0.6 mm. The posteroventral corner of the valve of the females examined bears denticles. The row of denticles continues to the middle of the posterior margin of the valve. The dorsal denticles characteristically directed dorsally. Rostrum hook-shaped anteriorly and dorsally. Valve with distinct reticulation (in formalin). Length 0.53 mm.

Male. Maximum height in the middle (Kiser, 1950). Posterior margin with 6–8 denticles. Valves with longitudinal lines. Rostrum hook-shaped. Antennules ending some distance before apex of rostrum. Postabdomen slightly tapering distally, with rounded distal dorsal end. Postanal denticles absent. Lateral setae present. Claws with 2 basal spines. Length 0.39 mm.

Distribution. North America, Pechora River (USSR).

13. **Pleuroxus letourneuxi** (Richard, 1888)
(Figures 251, 254–257)

Richard, 1888b:46 (Chydorus letourneuxi); 1894a:19 (Chydorus); Gurney, 1909:292, Plate XI, Figures 20–23 (Chydorus); Smirnov, 1966b:339 (obtusirostris); 1966c:163–167, 176, Figures 1–4.

Material. Several tens of females from Turkey (Kaotane; Floria, March 1939 (near Istanbul)). Preparations: females – MGU, ZIN, British Museum (London), University of Indiana (collection of Professor Frey, Bloomington, U.S.A.), Department of Hydrobiology, Biological Institute of the Czechoslovak Academy of Sciences (Prague), Zoological Institute in Hamburg, British Museum 77.1964.6.2.1, type Richard 78 Norman Collection 1911.11.8 M 4207. Ph – female 921.

Female. Outline of body almost circular. Height slightly less than length. Dorsal and ventral margin of valves strongly convex. Posterior margin almost straight, about $^1/_3$ maximum height of body. Valves with distinct posterodorsal corner. Posteroventral corner rounded, without denticles. Head shield passing smoothly into dorsal margin. Dorsal side without keel.

Ventral margin of valve serrated anteriorly and in middle; ventral margin of valve with feathered setae. Valve with lines in anterior part and with irregular polygons in posterior part. Head shield with rounded anterior and posterior end. Head pores typical for the subfamily. Small pores situated halfway between the two large pores. Small pores situated lateral to median line of head shield, one of the small pores situated slightly anterior to the other. Rostrum directed ventrally.

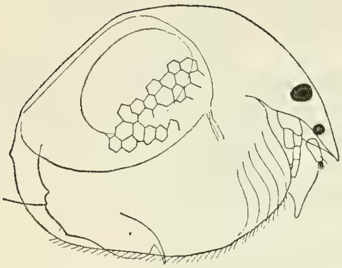

FIGURE 256. Pleuroxus letourneuxi, ephippial female (after Gurney, 1909)

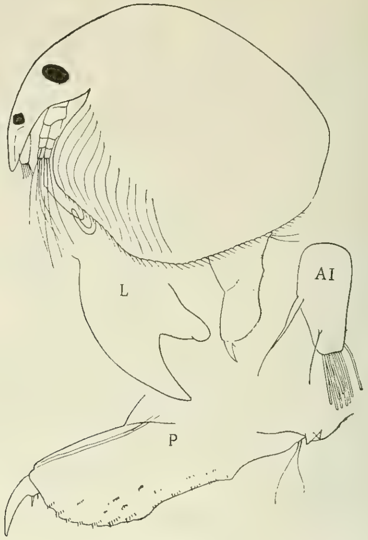

FIGURE 257. Pleuroxus letourneuxi, male, left side:

L, P – after Gauthier, 1928b; AI – after Gurney, 1909.

255 Antennules thick, slightly tapering distally, not reaching apex of rostrum but more than half length of rostrum. Antennules with a sensory seta distal to middle of outer margin. All sensory papillae situated on distal end, some of them short, others long. Antennae ending before apex of rostrum. Setae on antennae: 0–0–3/1–1–3; spines absent. Plate of labrum with convex anterior margin and pointed apex.

Postabdomen short. Preanal corner differentiated but not projecting or pointed. Anal margin almost straight, with setae. Postanal margin convex, with about 9 groups of setae; the bases of the setae near to the claws are situated on the outline of the postabdomen, while the bases of the setae situated far from the claws pass to the lateral surface of the postabdomen. Lateral side of postabdomen with two rows of groups of setae; setae arranged in a curve in each group. Ventral side of postabdomen with incisions which bear setae. Claws with 2 small basal spines, the distal spine slightly larger.

Intestine forming loops, with a caecum before the hind intestine. Ocellus slightly smaller than eye. Base of leg I bent at right angles to the leg; anterior margin convex, posterior margin concave. Anterior side with 9 rows of small setae. Outer ramus of endite with 3 setae, including one seta which is half the length of the others. Leg II with large setae on ventral margin of endite and with a well developed gnathobase with a row of filtering setae. Leg III with well developed exopodite and a gnathobase with a row of filtering setae. Row of filtering setae on gnathobase continuing into row of filtering setae on endite. Exopodite with 4 setae of different length, distally, its dorsal margin with 3 setae. Leg IV with a very large unsegmented exopodite with 7 setae. Row of filtering setae on gnathobase continuing into the row of filtering setae on endite. Epipodite and, proximal to it, the preepipodite distinctly visible. Leg V with a very large unsegmented exopodite with 3 setae on the posterior side and one seta on the opposite side. Epipodite and, above it, the preepipodite distinctly visible. Anterior side of leg with a rounded lobe. Length about 0.54 mm.

Male. Ventral margin more strongly convex than dorsal margin. Ventral margin of valve slightly concave anteriorly. Rostrum blunt. Antennules not reaching to apex of rostrum. Two lateral sensory setae. Distal segments of antennae not reaching apex of antennules. Plate of labrum with convex anterior margin and pointed apex. Postabdomen with rounded dorsal distal corner. Anal denticles short, in groups. Groups of lateral setae present. Claws with 2 basal spines. Vas deferens opening ventrally, near base of claws. Hook of leg I with 2 spinules on distal end. Anterior side of endite of leg I with a group of strong setae opposite distal end of hook. Length 0.35 mm.

At low magnification, this species may be identified as Chydorus. Its position in the genus Pleuroxus is proved by the morphology of the antennules, antennae, postabdomen, and legs, and particularly by the absence of the row of setae on the inner surface of the ventral margin of the valves.

Pleuroxus letourneuxi differs from other species of Pleuroxus in the absence of postanal denticles and of denticles on the posteroventral corner of the valves, and in the rounded apex of the rostrum.

In females of known species of Pleuroxus, anal denticles are absent in P. caca (but groups of anal setae are present); the posteroventral corner of the valves of P. caca, P. chappuisi, and P. pamirensis has no denticles. This is the first time a rounded apex of the rostrum has been found in the genus Pleuroxus.

Distribution. Mediterranean.

14. **Pleuroxus caca** Harding, 1955 (Figure 258)

Harding, 1955:347, Figures 79–82.

Material. Holotype, British Museum 77.1954.8.9.81.

Female. Integument with crests ending before the free margins of the valve and the head shield. Crests situated usually at right angles to long axis of body in ventral half of valves and parallel to axis of body in dorsal half of valves. Posterior margin $^{1}/_{3}$ maximum body height. Posteroventral corner rounded, without denticles. Dorsal margin strongly convex. Rostrum long, pointed. Antennules ending more than their own length before apex of rostrum. Distal segments of antennae projecting beyond apex of antennules but not reaching apex of rostrum. Plate of labrum with convex anterior margin and pointed apex.

Postabdomen with rounded dorsal distal corner. Dorsal margin of postabdomen with 10 groups of anal setae. Small lateral setae forming

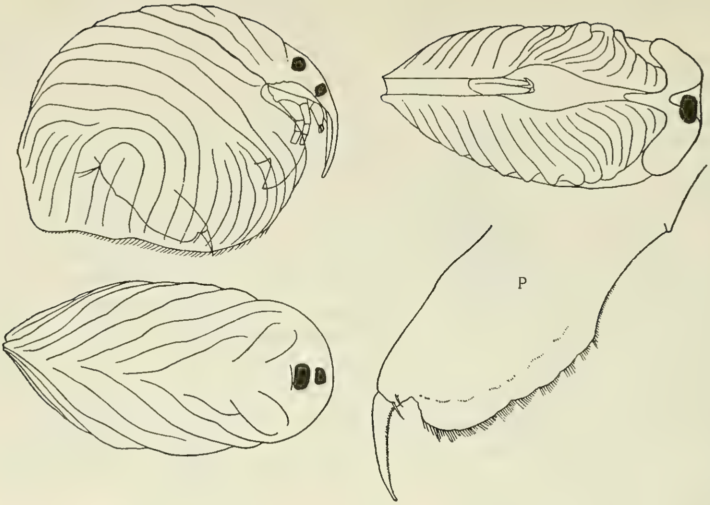

FIGURE 258. Pleuroxus caca, female (after Harding, 1955)

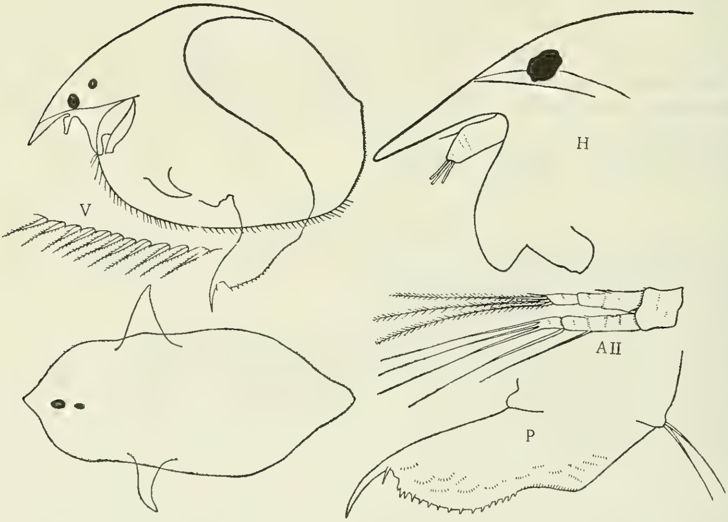

FIGURE 259. Pleuroxus pamirensis, female (after Vereshchagin, 1923)

curved groups. Ocellus situated nearer to eye than to apex of rostrum. Length to 0.6 mm.

Male. Unknown.

Distribution. South America.

257 15. **Pleuroxus pamirensis** (Werestschagin, 1923) (Figures 259–261)

Vereshchagin, 1923:33–36, 39–40, Plates II, III (Cornuella); Rylov, 1940:338 (Cornuella).

Material. Three females from Lake Zor–Kul' in Pamir. Preparations: ZIN – 1/43533.3; the test tube contains three females, one of which is markedly larger than the others and may be considered as the lectotype.

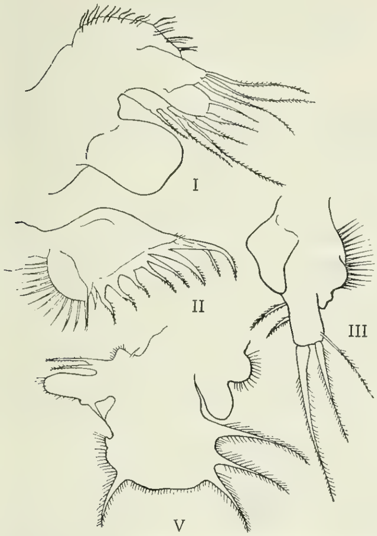

FIGURE 260. Legs of female of Pleuroxus pamirensis (after Vereshchagin, 1923)

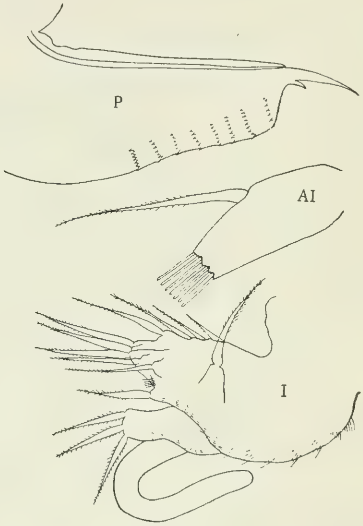

FIGURE 261. Pleuroxus pamirensis, male (after Vereshchagin, 1923)

Female. Valves with distinct posterodorsal corner; posteroventral corner rounded, without denticles. Surface of valve smooth. There is a process which is curved posterodorsally in anterior third of valve at about $^1/_3$ height from ventral margin. Rostrum pointed.

Antennules reaching to half of rostrum, tapering distally, with a seta on the anterior margin. Exopodite of antennae slightly longer than endopodite; setae: 0–0–3/1–1–3. Basal segment with a spine on the outer side. Distal end of proximal segment of endopodite with a spine half the length of the middle segment. Segments with transverse rows of setae. Distal segments of both rami with a spine. Plate of labrum with rounded apex.

Postabdomen with rounded distal dorsal corner. There are 13–16 anal denticles decreasing in size proximally and passing into a row of setae.

Lateral groups of spinules present, the distal spinules curved, the proximal ones straight. Intestine forming loops. Ocellus larger than eye, its distance to eye half its distance to apex of rostrum. Legs typical of the genus. Leg IV not described. Length to 0.8 mm.

Male. Valves with lateral processes. Lateral seta of antennules large. Postabdomen slightly tapering distally. From 8 to 9 transverse rows of spinules laterally. Length to 0.66 mm.

Distribution. Pamir.

Species incertae sedis

Pleuroxus aduncoides Dybowski and Grochowski, 1895:152. Nomen nudum.

Pleuroxus affinis Herrick, 1884:111, Plate H., Figure 2.

Pleuroxus armatus (Gay, 1849). Gay, 1849:292 (Lynceus).

Pleuroxus bartenevi Schiklejew, 1929:31–32, Figures 22, 23; 1930b:346–347, Figures 19, 20.

258 According to Bening (1941), P. bartenevi Schiklejew is obviously not valid because of the improbable characters given in the description. Shikleev (1929) stated that the concave side of the claws is directed opposite to the direction observed in the other Chydoridae, and that the basal spinules are situated at the base of the convex side. Since such claws have not been found in other Chydoridae (or in other Cladocera), the validity of this species is doubtful. This is apparently a description of a malformed specimen, since the postabdomen shows signs of malformation (irregular arrangement of the anal denticles).

Pleuroxus insculptus Birge, 1879:19–20, Plate II, Figure 12.

Pleuroxus Kijowiensis Dybowski and Grochowski, 1895:152.

Nomen nudum. Rhypophilus Kijoviensis is described under a different number on p. 153.

Pleuroxus nasutus (Gay, 1849). Gay, 1849:291 (Lynceus).

Pleuroxus puteanus Rehberg, 1882:63–64.

Pleuroxus retrocurvatus Bergamin, 1939:Plate II, Figure 2; 1940:48, Figure 1 (P. retrocurvatus Bergamin, 1931 is a reference to an unpublished dissertation of Bergamin, 1931; Estudio systematico des Cladocera des aguas do municipio de S. Paulo. These inaugural).

Pleuroxus straminius Birge, 1879:18–19, Plate II, Figure 11; Herrick, 1884:108 (stramineus).

According to Herrick (1884), probably a synonym of P. laevis.

Pleuroxus ternispinosus Ekman, 1900:81, Plate 4, Figure 30; Brehm, 1925b:307 (tenuispinosus).

5. Genus Alonella Sars, 1862

Baird, 1843:92 (Acroperus part); Sars, 1862a:40 (Alonella; Alona part); Schoedler, 1863:32–33, 49–52 (Lynceus, Pleuroxus, Acroperus); Kurz, 1875:62–64; Herrick, 1884:101–102 (section

Alonella); Lilljeborg, 1900:509–510; Daday, 1905:161 (Alonella); Birge, 1910:1048–1051; Sars, 1916:338; Bergamin, 1941:165; Bening, 1941:318 (Alonella); Šrámek-Hušek et al., 1962:360–361 (Alonella); Herbst, 1962:92.

Type species: Alonella excisa (Fischer, 1854).

Female with oval outline. Reticulation of valves in form of polygons or lines. Setae situated on ventral margin of valve but not on the inner side. Antennules ending less than their length from apex of rostrum or projecting beyond it. Setae on antennae: 0–0–3/0–1–3. Five pairs of legs. Leg I with rows of setae on anterior surface of endite. Outer branch of endite with 3 setae, one of them hook-shaped. Leg II triangular, with narrow gnathobase. Leg III has rectangular exopodite with 4 setae on the posterior margin and 3 setae on the dorsal margin. Setae of posterior margin about double length of exopodite, setae of dorsal margin not longer than exopodite. Leg IV with large exopodite with 7 setae which become gradually larger from the anterior to the posterior setae. Two anterior setae sparsely pubescent, other setae feathered. Leg V with large exopodite with 4 setae including one small seta on anterior side of exopodite and 3 large setae on posterior side. Male smaller than female. Male distinguished by the modified leg I and narrowing postabdomen, which has no anal denticles in the adult male. Vas deferens opening at base of claws.

The genus Alonella differs little from Pleuroxus. The only distinct character of the genus Alonella is that the head pores are situated near the posterior margin of the head shield, i. e., the distance from the head pores to the posterior margin of the head shield is less than that between the main pores. However, data on the head pores are available for only a few species. For differences between the genera Pleuroxus and Alonella it is advisable to consult the original description of Alonella. Sars (1862b: 288–289) describes the genus Alonella as follows: "... 3 forms which I placed in this genus (Alona pygmaea, elongata, and falcata) differ in some characters from it; I noted earlier that it would be best to place these forms in a separate subgenus, although at least 2 of them show distinct affinities to other genera, and it is not clear in which genus they should be placed. For the first of these forms, viz., A. pygmaea, I propose the generic name Alonella. In addition to the species mentioned above, this genus contains two other forms collected and described by me, i.e., Lynceus rostratus Koch and L. excisus Fischer and probably two other Lynceidae which I have not yet found, viz., Acroperus nanus Baird and Lynceus exiguus Lilljeborg. All these species, as regards the form of the valve and other characters, show close affinities to the rather distant genera Pleuroxus and Peracantha and to the genus Alona; Schoedler therefore also placed L. excisus Fischer in the genus Alonella. However, the species discussed here differ from the genus Pleuroxus in that their head is immobile and never so strongly compressed; the structure of the valve is also markedly different."

259 Before the distinct differences between Alonella and Alona became known, many authors thought that it was impossible to distinguish between these two genera. Thus, Gurney (1927:76) stated that some species can be placed with equal justification in Alona or in Alonella because the difference between these two genera is so unclear. Frey (1961b:137)

wrote that the genus Alonella was considered until recently as a kind of convenience for species which could not be placed with certainty in a more clearly defined genus. Frey further stated that Alonella was considered as closely related to Alona. Johnson (1956b) also considered Alonella as related to Alona. In order to remove any doubts as to the definition of Alonella it is necessary to examine the legs and head pores of the species of this genus. Alonella can now be clearly distinguished from Alona by the structure of the head pores and legs. There was confusion for a long time because of resemblances between some species of Alonella and Alona and attempts were therefore made to find reliable criteria for determining the genus of the species of Chydoridae involved. Alonella is therefore the only genus for which a division into subgenera was proposed.

Birge (1879, 1910, 1918) proposed the following three subgenera of the genus Alonella.

1. Subgenus Pleuroxalonella Birge, 1910. Birge (1910) placed in this subgenus those species in which the rostrum is slightly longer than the antennules and not curved, viz., A. excisa (Fischer), A. exigua (Lilljeborg), and A. breviceps Stingelin. Later Brehm (1933) added A. nasuta Smith and A. granulata Brehm. Brehm also placed in this subgenus A. brachycopa (insufficiently described) and A. nitidula (which we place in the genus Chydorus because of the presence of a row of setae on the inner surface of the ventral margin of the valve).

2. Subgenus Alonella s. str. Birge, 1910. Rostrum long, curved, much longer than antennules. Postabdomen has only anal denticles. A. rostrata (Koch), A. dadayi Birge, and A. acutirostris Birge were also placed in this subgenus. These species now form the genus Disparalona. Birge also placed A. nana (Baird) in the subgenus Alonella s. str.

3. Subgenus Paralonella Birge, 1910. Rostrum hardly longer than antennules. Postabdomen with small anal denticles and usually with groups of lateral setae. This subgenus contains A. dentifera Sars and A. lineolata Sars. A. karua, A. davidi, and A. globulosa were also placed here, but our data on the structure of the legs and head pores prove that they belong to the subfamily Aloninae. A. dentifera also belongs to the genus Alonella because of the structure of the head pores. The morphology of the legs and head pores of A. lineolata is unknown. A. dentifera, the only species which can be placed with some justification in this subfamily, closely resembles the forms of the subgenus Pleuroxalonella in its general form and head pores. We believe therefore that there is no reason for retaining the subgenus Paralonella. Johnson (1956b) stated that Alonella may become a natural genus after elimination of the subgenus Paralonella (i.e., its transfer to the genus Alona).

Key to Species of the Genus Alonella according to Females

1 (16). Antennules almost reaching apex of rostrum.
2 (11). Valve with projecting posterodorsal and posteroventral corners.
3 (10). Valves with lines and reticulation.
4 (9). Valves with lines extending at first dorsally and then ventrally (Figure 267).

5 (8). Valves with longitudinal striation inside the polygons.

6 (7). Postabdomen with truncate apex . . . . 1. A. excisa (Fischer, 1854).

7 (6). Postabdomen with rounded tapering apex . . . . 2. A. pulchella Herrick, 1884.

8 (5). Valves without longitudinal striation inside polygons . . . . 3. A. exigua (Lilljeborg, 1853).

9 (4). Valves with lines extending anteroventrally-posterodorsally . . . . 4. A. nana (Baird, 1850).

10 (3). Valves punctate, without lines or reticulation . . . . 5. A. granulata Brehm, 1933.

11 (2). Valve with rounded, indistinct posterodorsal and posteroventral corners.

12 (15). Postabdomen with rounded end.

13 (14). Posteroventral corner of valve without denticles. Valve with longitudinal lines . . . . 6. A. lineolata Sars, 1901.

14 (13). Posteroventral corner of valve with denticles. Valve without longitudinal lines . . . . 7. A. dentifera Sars, 1901.

15 (12). Postabdomen with truncate end. Four distal teeth wide, the others setiform . . . . 8. A. nasuta Smith, 1909.

16 (1). Antennules ending far before apex of rostrum.

17 (20). Postabdomen widest in proximal part. Ocellus situated nearer to eye than to apex of rostrum.

18 (19). Height of posterior margin slightly less than maximum height. About 11 anal denticles . . . . 9. A. reticulata (Henry, 1919) comb. n.

19 (18). Height of posterior margin much less than maximum height. About 16 anal denticles . . . . 10. A. jugosa (Henry, 1919) comb. n.

260 20 (17). Postabdomen widest in distal part . . . . 11. A. unispina (Henry, 1922) comb. n.

Key to Species of Known Males of the Genus Alonella

1 (4). Postabdomen strongly tapering distally.

2 (3). Valves with longitudinal striation inside polygons. . . . . 1. A. excisa.

3 (2). Valves without longitudinal striation inside polygons . . . 3. A. exigua.

4 (1). Postabdomen not strongly tapering distally . . . . 4. A. nana.

1. Alonella excisa (Fischer, 1854)

Female. Posterior margin of valve almost straight, half maximum height. Posteroventral corner of valve serrated. Reticulation in form of lines extending from the anterior end posterodorsally. The lines are fused into a honeycomb pattern in some places. Fine longitudinal lines inside polygons. Rostrum blunt. Head shield with rounded posterior margin. Distance from head pores to posterior margin of head shield shorter than distance between main head pores. Antennules with a sensory seta distal to middle of margin. All esthetascs terminal, some of them reaching anterior margin of rostrum, others slightly longer and projecting beyond margin of rostrum. Setae on antennae: 0–0–3/1–1–3, spines: 1–0–1/0–0–1. Plate of labrum with convex anterior margin and blunt apex.

Postabdomen short. Anus with blunt proximal corner. Anal margin with setules. About 10 anal denticles. Claws with 2 basal spines. Ocellus slightly nearer to eye than to apex of rostrum. Legs typical for the genus. Outer branch of exopodite of leg I with 3 setae of slightly different length. Length to 0.45 mm.

Male. Posterodorsal corner of valves situated higher than in female. Ventral margin of valve with a process in the middle. Reticulation as in the female. Antennules with a 2-segmented flagellum in middle of anterior margin. Postabdomen narrowing, without anal denticles. Claws S-shaped, with 2 basal spines. Vas deferens opening at base of claws.

Biology. Monocyclic at vegetation periods of less than 6 months; if the vegetation period lasts 6–8 months, they are dicyclic and become gradually tricyclic and secondarily dicyclic later in the vegetation period (Vereshchagin, 1912c).

Key to Subspecies of A. excisa according to Females

1 (2). Posteroventral corner of valves with one or several blunt denticles . . . . 1a. **A. excisa excisa** (Fischer, 1854).
2 (1). Posteroventral corner of valves ending in a pointed denticle or rounded . . . . 1b. **A. excisa clathratula** Sars, 1896.

1a. **Alonella excisa excisa** (Fischer, 1854)
(Figures 262, 263, 264)

Lilljeborg, 1853:206 (Lynceus nanus); Fischer, 1854:428–429, Plate 3, Figures 11–14 (L. excisus); Schoedler, 1862:26, Plate II, Figure 38 (Pleuroxus excisus); 1863:49, Plate 2, Figure 38 (P. excisus); Frič, 1872 (Lynceus exiguus); Matile, 1890:49, Figures 38, 38a, 38b (Pleuroxus excisus); Wesenberg-Lund, 1895:127, Plate IV, Figure 16 (P. exiguus); Stingelin, 1895:253, Plate VII, Figures 38, 39 (P. excisus); Lilljeborg, 1900:510–513, Plate LXXII, Figures 9–19 (excisa); Vereshchagin, 1913a:204–205, Figures 26–27 (setosa); Bening, 1941:320–323, Figure 133; Frey, 1959:38, Figure 41 (excisa); 1962a, Figure 41; Šrámek-Hušek et al., 1962:361–363, Figure 135 (excisa); Herbst, 1962:94, Figure 76 (excisa); Negrea, 1966a:146 (excisa); Smirnov, 1966c, Figure 19 (excisa); Fryer, 1968:180–182, Figure 53 (excisa); Rey and Saint-Jean, 1968:113, Figure 27 (excisa).

Material. Numerous females from the Rybinsk Reservoir, the Vashutkiny Lakes in the Arkhangelsk Region, the delta of the Terek, and Lake Kyla-Kol' in Southern Kirghizia. Several females from the Lenkoran' district, from Lake Bugun-Kul' in the Aktyubinsk Region, One female from Lake Issyk-Kul'. Several females from the Altai Territory. Preparations: MGU – females 542, 546, 547, 414, 542, 545, male 1512. ZIN – female 53880 (543), male 53881 (1493). Ph – female 1223, male 1500.

Female. Posteroventral corner of valve with one or several blunt denticles.

Distribution. Ubiquitous.

(261)

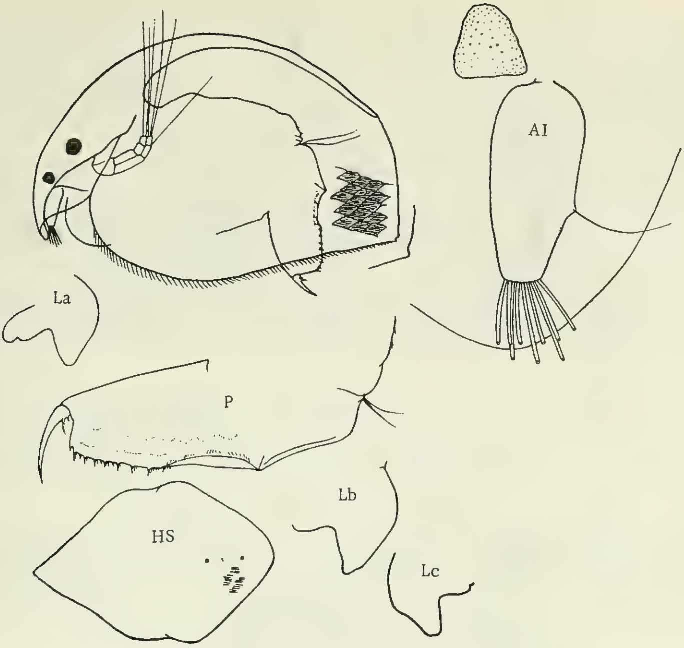

FIGURE 262. Alonella excisa excisa, female, length 0.33 mm:

La — Rybinsk Reservoir, 15 August 1962; Lb — Rybinsk Reservoir, 21 June 1962, preparation 543; Lc — Rybinsk Reservoir, 3 May 1962, preparation 414; P — Lenkoran' district, 25 May 1963; HS — after Frey, 1962a; AI — right antennule, ventral (Rybinsk Reservoir, Borok, 3 May 1962).

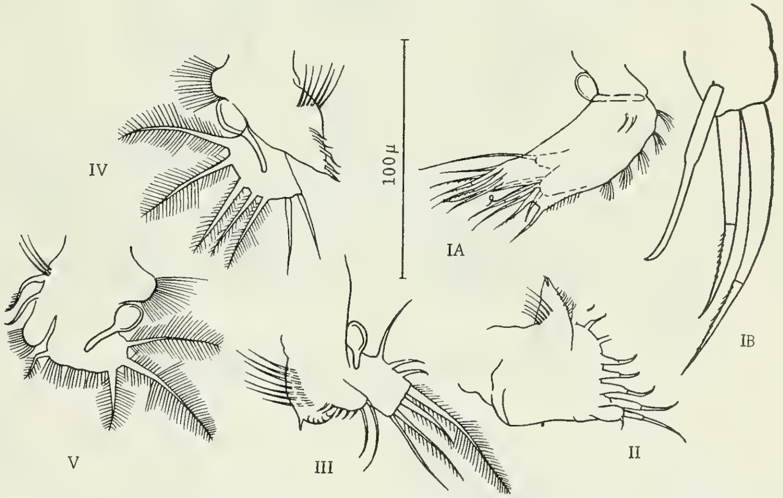

FIGURE 263. Legs of female of Alonella excisa excisa, left side (Rybinsk Reservoir, 3 May 1962):

IA, IV — inner side; IB — outer branch of endite, outer side; II, III, V — outer side.

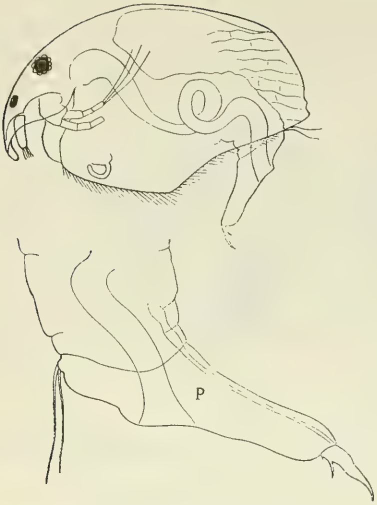

FIGURE 264. Alonella excisa excisa, male (after Lilljeborg, 1900)

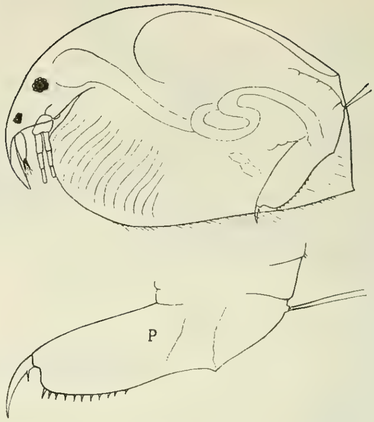

FIGURE 265. Alonella excisa clathratula, female (after Sars, 1886)

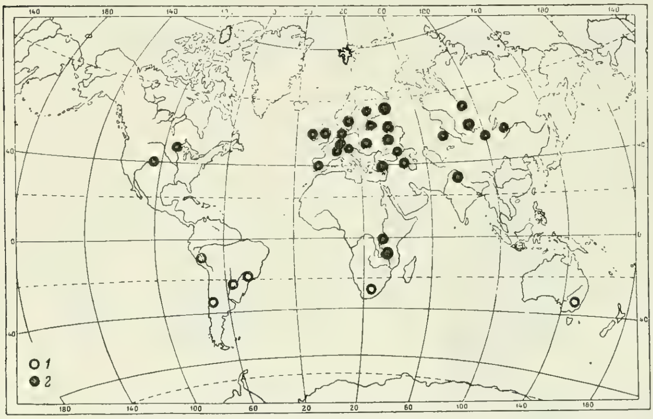

FIGURE 266. Distribution:

1 – Alonella excisa clathratula; 2 – A.exigua exigua.

1b. **Alonella excisa clathratula** Sars, 1896 (Figures 265, 266)

Sars, 1896b:43–45, Plate 6, Figures 7–8 (clathratula); 1901:62–63, Plate X, Figures 5, 5a (clathratula); Grochmalicki, 1915:225–226, Plate 6, Figures 7a, b (kulczynskii syn. n); Delachaux, 1919:31, Plate III, Figure 6 (var. clathratula); Henry, 1922:48–49, Plate VI, Figure 6, 6a (clathratula); Harding, 1955:345, Figures 69–70 (var. clathratula).

263 Female. Posterior margin smooth. Posteroventral corner almost forming a right angle, ending in a single denticle or rounded. Rostrum pointed. Valves with reticulation, with transverse lines anteriorly. Claws with one basal spine (Henry, 1922: Brehm, 1933b). Length to 0.45 mm.

Distribution. Neotropical Region, South Africa, Australia, Java.

2. **Alonella pulchella** Herrick, 1884 (Figure 267)

Herrick, 1884:103, Plate Q, Figures 1, 2, 3.

Material. According to description.

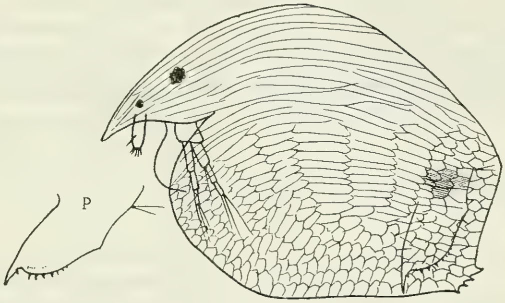

FIGURE 267. Alonella pulchella, female (after Herrick, 1884)

Female. Ratio of height to length 1:1.3. Posteroventral corner of valve with 4 denticles pointing in different directions. Valves with reticulation; polygons short ventrally, oblong dorsally; head shield with longitudinal lines. Polygons with longitudinal striation. Antennules almost reaching apex of rostrum. Postabdomen with blunt distal dorsal end. Preanal corner differentiated. Anal denticles and lateral setae present. Length 0.27 mm.

Male. Unknown.

Distribution. Minnesota, U.S.A.

3. **Alonella exigua** (Lilljeborg, 1853)

Female. Maximum height in middle, ratio of height to length 1:1.6. Posterior margin of valve straight, half maximum height. Posterodorsal corner of valve distinct. Posteroventral corner of valve with a denticle and another one ventral to it; 1–2 denticles dorsally. Denticles very variable and having a different number on the right and left valve. Valves with lines extending anterodorsally-posteroventrally; some polygons without longitudinal striation. Rostrum blunt. Head shield with exposed posterior margin. Distance from head pores to posterior margin of head shield shorter than distance between main pores (Frey, 1959, 1962a). Reticulation of head shield like that of valve. Antennules ending a short distance before apex of rostrum, with a sensory seta distal to middle of posterior margin. Setae on antennae: 0–0–3/0–1–3. Plate of labrum with convex anterior margin and pointed apex.

Postabdomen tapering distally. Preanal corner projecting. Anal margin with setules. Distal dorsal margin with 2 rows of about 10 anal denticles. Claws with 2 basal spines. Ocellus situated halfway between eye and apex of rostrum. Legs typical for the genus. Length to 0.42 mm.

Male. Posterior margin half maximum height. Valve with distinct posterodorsal corner. Antennules almost reaching apex of rostrum; esthetascs of different length and projecting beyond margin of rostrum. Sensory seta situated slightly distal to middle of ventral margin of antennule. Postabdomen narrowing distally. Preanal corner distinct. Dorsal margin without anal denticles. Lateral setae present. Claws with 2 basal denticles. Vas deferens opening at base of claws. Antennules, eye, and ocellus relatively larger than in the female. Length to 0.27 mm.

Juvenile male. Postabdomen as in female.

Key to Subspecies of A. exigua according to Females

1 (2). Posteroventral corner of valve with denticles. . . . . 3a. A. exigua exigua (Lilljeborg, 1853).
2 (1). Posteroventral corner of valve rounded, without denticles . . . . 3b. A. exigua mutica Lilljeborg, 1900.

266 3a. Alonella exigua exigua (Lilljeborg, 1853)

(Figures 266, 268–271)

Fischer, 1851:192, Plate X, Figures 1, 2 (Lynceus aculeatus); Lilljeborg, 1853:79, Plate VII, Figures 9, 10 (L. exiguus); Schoedler, 1863:51 (Pleuroxus exiguus); 52–53 (P. aculeatus); P.E. Müller, 1867:187–188, Plate IV, Figures 16, 17; Norman and Brady, 1867:384–385, Plate XXI, Figure 3, Plate XVIII, Figure 3 (Lynceus exiguus); Kurz, 1875:64–65, Plate 3, Figure 6; Daday, 1888:91, Plate 1, Figures 38–39 (Pleuroxus transylvanus syn. n., described after specimen with malformed postabdomen); Matile, 1890:152, Plate V, Figures 39, 39a (Pleuroxus griseus); Lilljeborg, 1900:513–517, Plate LXXII, Figures 20, 26 (exigua); Arévalo, 1916:60, Figure 24 (hispanica); Bening, 1941:323–325, Figure 134 (exigua); Frey, 1959:38, Figure 41; 1962a, Figure 41 (exigua); Šrámek-Hušek et al., 1962:363–365, Figure 136 (exigua); Herbst, 1962:94, Figure 77 (exigua); Fryer, 1968:272–280, Figures 50, 51, 52 (exigua).

(264)

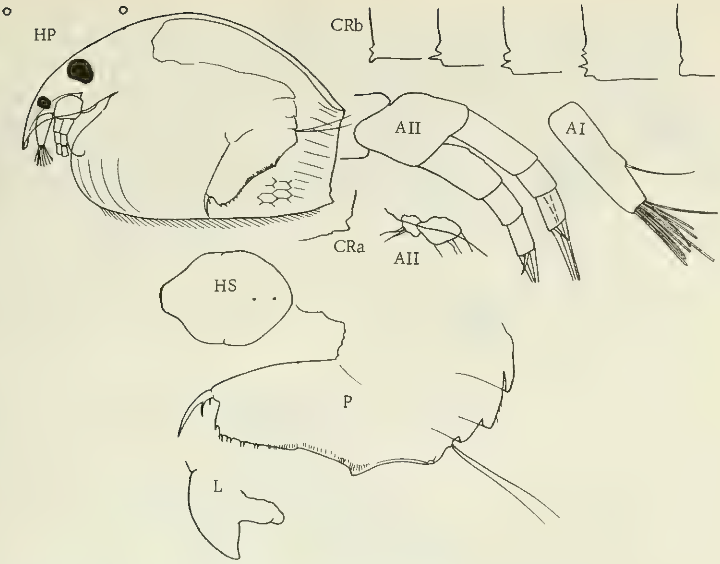

FIGURE 268. Alonella exigua exigua, female, length 0.32 mm:

P, L, AI, AII — Cherepovets Reservoir; CRa — posteroventral corner of right valve; HS — after Frey, 1962a; HP — Lake Poletskoe, Moscow Region, 22 August 1963, preparation 1034; CRb — after Vereshchagin, 1912a.

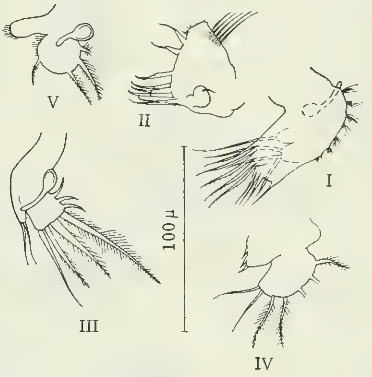

FIGURE 269. Legs of female of Alonella exigua exigua (Cherepovets Reservoir, Goritsy, 21 October 1963):

I — left leg, inner side; II, V — right legs, outer side; III — left leg, outer side; IV — right leg, inner side.

(265)

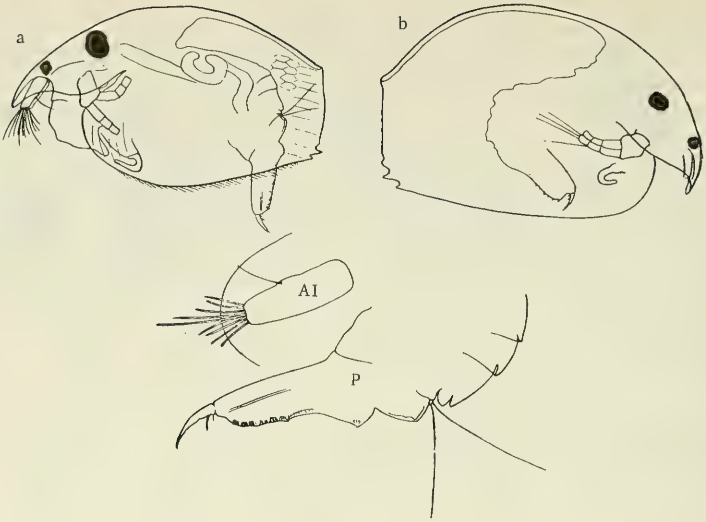

FIGURE 270. Alonella exigua exigua:

a – adult male, left side, length 0.31 mm (Cherepovets Reservoir, Goritsy, 21 October 1963); b – juvenile male, length 0.28 mm (Shugor River, kurya,* Komi ASSR, 24 August 1958, preparation 1522).

* [Long narrow oxbow, detached from river at upper end only.]

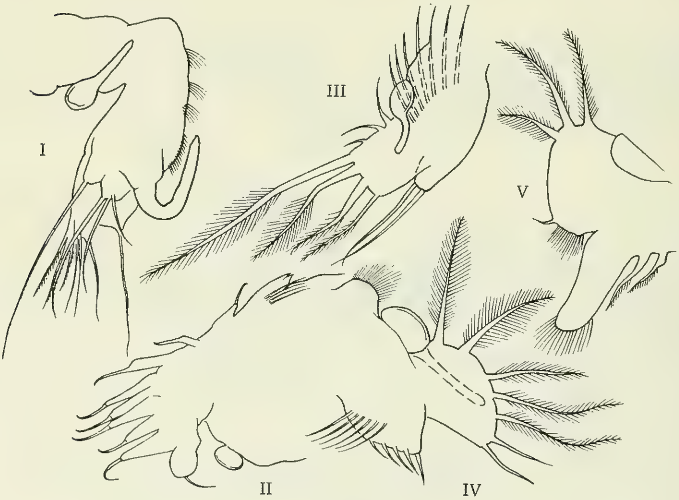

FIGURE 271. Legs of male of Alonella exigua exigua, right side (Cherepovets Reservoir, 21 October 1963):

I, II, V – outer side; III, IV – inner side.

Material. Numerous females from the Cherepovets Reservoir, Lake Poletskoe in the Moscow Region, the Komi ASSR, and ponds in the Perm Region. Two females from Lake Karnak-Kul' in the Aktyubinsk Region. One female from the White Nile. Several females from a pond near the port of Macquarie, Australia. Numerous males from the Cherepovets Reservoir and the Komi ASSR. Preparations: MGU – females 933, 1026, 933, 1028, 1033, 1034, males 1508, juvenile male 1522. ZIN – female 53882 (1028), male 53883 (1511). Ph – female 1480, male 1507.

Female. Posteroventral corner of valve with denticles of varying number and form.

Distribution. Holarctic and Ethiopian regions, European USSR as far as the Baikal area in the east.

3b. **Alonella exigua mutica** Lilljeborg, 1900

Lilljeborg, 1900:516 (f. mutica).

Material. According to description.

Female. Posteroventral corner of valves rounded, without denticles.

Distribution. Sweden, Estonian SSR.

4. **Alonella nana** (Baird, 1850) (Figures 272–275)

Baird, 1843:92, Plate III, Figure 8 (Acroperus nanus); 1850:130, Plate XVI, Figure 6 (Acroperus nanus); Lilljeborg, 1853 (Lynceus nanus); Sars, 1862a:162–163 (Alona pygmaea); 1862b:288, 301 (pygmaea); Schoedler, 1862:26 (Pleuroxus transversus); 1863:33 (Acroperus nanus), 50, Plate 3, Figures 52, 53 (Pleuroxus transversus); P.E. Müller, 1867:181–182, Plate IV, Figures 10, 11 (Alona transversa); Kurz, 1875:67–68, Plate III, Figure 7; Hellich, 1877:100 (Pleuroxus nanus); Daday, 1883:9–11, Plate 1, Figures 2, 5 (P. tusnadiensis); 1884:180 (P. tusnadiensis); 1888:90, Plate I, Figures 27, 28, 29 (P. tusnadiensis); 92, Plate I, Figures 22, 23 (P. griseus); Sars, 1891:48; Lilljeborg, 1900:517–520, Plate LXXII, Figures 27–31; Bening, 1941:319–320, Figure 132; Frey, 1959:38, Figure 43; 1962a, Figure 43; Šrámek-Hušek et al., 1962:365–366, Figure 137; Herbst, 1962:94, Figure 75; Negrea, 1966a:146; Fryer, 1968:283–286, Figures 54, 55.

Material. Several females from the Komi ASSR. One female from a lake near Orenburg. Preparations: MGU – female 95. ZIN – female 53884 (1778).

Female. Dorsal margin strongly convex. Posterodorsal corner of valve situated in median line. Posterior margin almost straight. Posteroventral corner of valve with one, sometimes with two denticles. Lines on valve directed anteroventrally-posterodorsally. Rostrum pointed. Head shield with rounded posterior margin. Distance from head pores to posterior margin of head shield shorter than distance between main pores (Frey, 1959). Antennules with a sensory seta distal to middle of posterior margin. Setae on antennae: 0–0–3/0–1–3. Plate of labrum with pointed apex.

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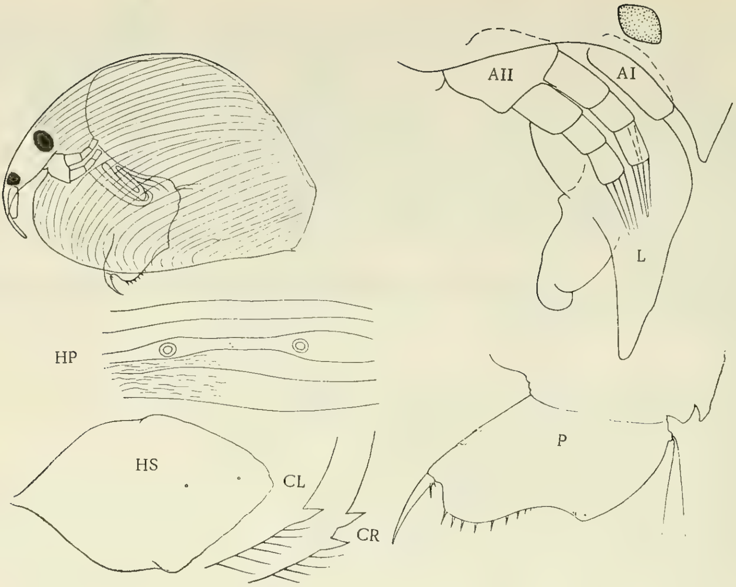

FIGURE 272. Alonella nana, female, length 0.23 mm (Shchugor River, brook, Komi ASSR, preparation 95):

HS — after Frey, 1962a; CL, CR — Lem'yu River, Komi ASSR, 20 August 1964, preparation 1778, anterior margin of head from the right side; HP — Pechora River near Kuz'dibozh, Komi ASSR, 16 August 1963.

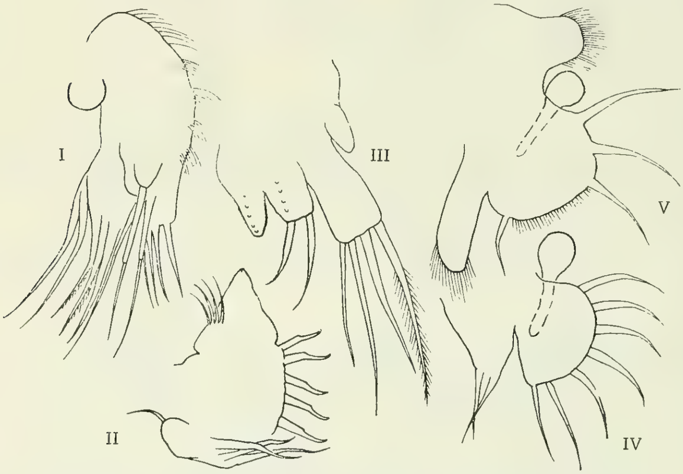

FIGURE 273. Legs of female of Alonella nana, right side (Pechora River, Kuz'dibozh, 16 August 1963):

I, II — outer side; III, IV, V — inner side.

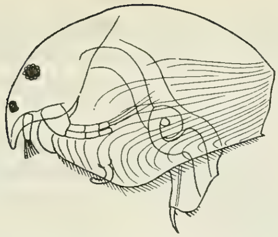

FIGURE 274. Alonella nana, male (after Lilljeborg, 1900)

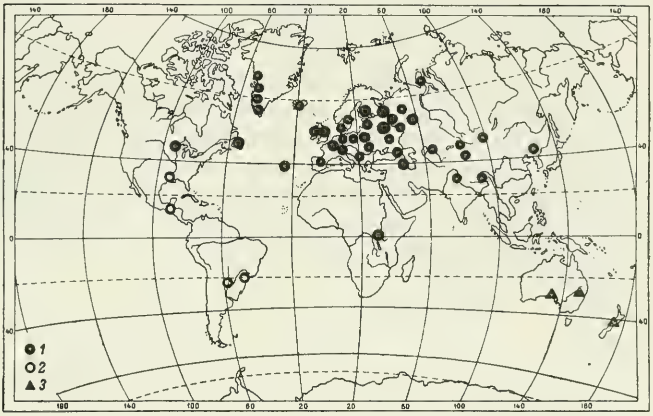

FIGURE 275. Distribution:

1 — Alonella nana; 2 — A. dentifera; 3 — A. unispina.

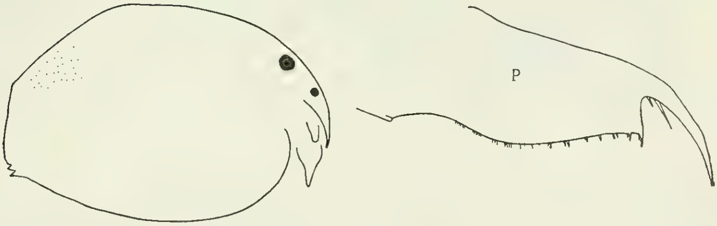

FIGURE 276. Alonella granulata, female (after Brehm, 1933b)

Postabdomen short. Proximal corner of anus distinct. About 6 anal denticles. Claws with 2 basal spines, proximal spine small, its concave margin with setae (Frey, 1958). Intestine with loops in 1.5 turns. Ocellus nearer to eye than to apex of rostrum. Legs typical for the genus. Length to 0.26 mm.

Male. Valve with a process on ventral margin. Posteroventral corner of valve with a denticle. Antennules not reaching apex of rostrum, with a 2-segmented flagellum distal to middle of anterior margin. Postabdomen short, wide; about 5 anal denticles. Preanal corner projecting. Claws with a basal spine. Intestine forming loops. Ocellus situated halfway between eye and apex of rostrum. Length to 0.24 mm.

Distribution. Holarctic Region, European USSR to Baikal area.

5. **Alonella granulata** Brehm, 1933 (Figure 276)

Brehm, 1933a:737–738, Figures 34, 35.

Material. According to description.

270 Female. Posterior margin of valve less than maximum height by a factor of 2.5. Posteroventral corner with denticles. Valve punctate. Rostrum pointed. Antennules not reaching apex of rostrum. Plate of labrum with pointed apex. Postabdomen slightly tapering distally. Preanal corner not projecting. Lateral setae absent. Ocellus nearer to eye than to apex of rostrum. Length to 0.38 mm.

Male. Unknown.

Distribution. Java, Brazil.

6. **Alonella lineolata** Sars, 1901 (Figure 277)

Sars, 1901:58–59, Plate X, Figures 1, 1a.

Material. According to description.

Female. Maximum height in middle of body. Posterodorsal and posteroventral corners of valve rounded. Valve with longitudinal lines parallel to dorsal margin. Antennules almost reaching apex of rostrum. Plate of labrum rounded. Postabdomen with slightly projecting preanal corner. Distal margin rounded, slightly projecting. Anal denticles small, situated in distal part of dorsal margin of postabdomen. Lateral setae absent. Claws with small basal spine. Ocellus situated slightly nearer to eye than to apex of rostrum. Length 0.31 mm.

Male. Unknown.

Distribution. Southern Brazil.

7. **Alonella dentifera** Sars, 1901 (Figures 275, 278, 279)

Sars, 1901:61–62, Plate X, Figures 4, 4a; Daday, 1905:162–163, Plate X, Figures 10, 11; Frey, 1959:38, Figures 45, 46; 1962a, Figures 45, 46.

Material. According to description.

Female. Maximum height of valve far before middle. Valve slightly reticulate. Rostrum blunt. Head shield with broadly rounded posterior

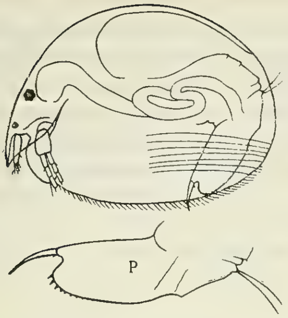

FIGURE 277. Alonella lineolata, female (after Sars, 1901)

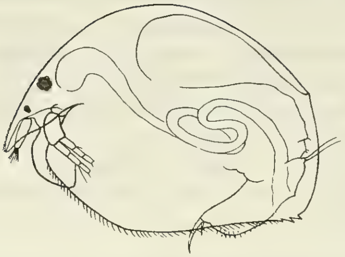

FIGURE 278. Alonella dentifera, female (after Sars, 1901)

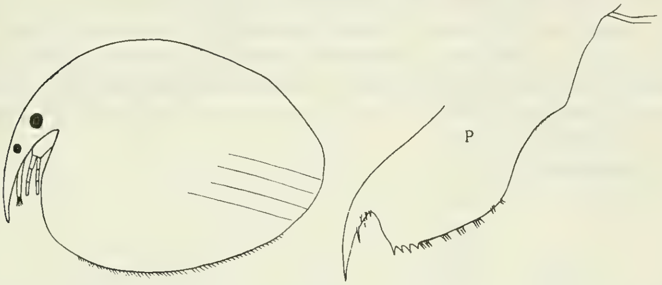

FIGURE 280. Alonella nasuta, female (after Smith, 1909)

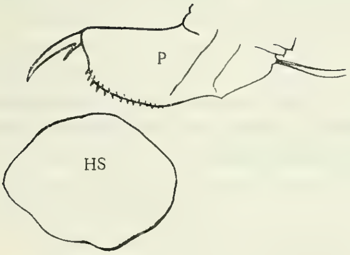

FIGURE 279. Alonella dentifera, female:

P – after Sars, 1901; HS – after Frey, 1962a.

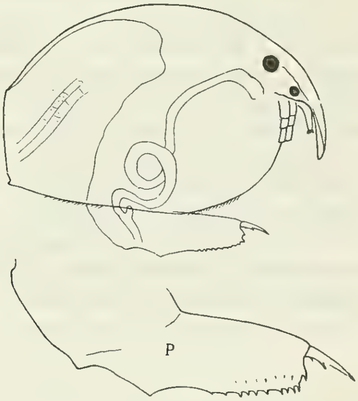

FIGURE 281. Alonella reticulata, female (after Henry, 1922)

margin. Head pores situated near posterior margin of head shield. Posteroventral corner of valve with 1–3 denticles. Antennules ending a short distance before apex of rostrum. Plate of labrum rounded. Postabdomen with slightly projecting preanal corner. Distal margin rounded, not projecting. According to Brooks (1959), about 12 anal denticles and about 12 lateral groups of setae. Claws with a long basal spine. Intestine forming loops, with 1.5 turns. Ocellus situated slightly nearer to eye than to apex of rostrum.

Male. Length 0.35 mm.

Distribution. North and South America (Figure 275).

8. Alonella nasuta Smith, 1909 (Figure 280)

Smith, 1909:84, Plate 16, Figures 4, 5.

Material. According to description.

Female. Posterodorsal and posteroventral corners of valve rounded. Valves with longitudinal lines, without striation. Rostrum long. Antennules not reaching apex of rostrum. Postabdomen with 4 short wide anal denticles and about 5 groups of setae. Anal margin concave. Claws with 2 basal spines (Brehm, 1933b). Ocellus situated nearer to eye than to apex of rostrum. Length 0.5 mm.

Male. Unknown.

Distribution. Tasmania.

9. Alonella reticulata (Henry, 1919) comb. n. (Figure 281)

Henry, 1919:478–479, Plate XLII, Figures 13, 14 (Pleuroxus reticulatus); 1922, Plate VII, Figures 2, 2a (P. reticulatus).

Material. According to description.

Female. Maximum height before middle of body. Valve with straight posterior margin. Posterodorsal corner distinct. Posteroventral corner ending in a blunt denticle. Valve reticulate and punctate. Rostrum pointed. Antennules one half length of rostrum. Postabdomen widest in proximal part. Preanal corner differentiated, blunt. Claws with 2 basal spines, proximal spine very small. About 11 anal denticles. Lateral setae in 7 groups. Intestine forming loops, with a caecum. Ocellus situated nearer to eye than to apex of rostrum.

Male. Unknown.

This form resembles species of Alonella and is placed in this genus until a more detailed study is made. The genus cannot be determined with certainty, since the head pores have not been described.

Distribution. Southeast Australia.

10. Alonella jugosa (Henry, 1919) comb. n. (Figure 282)

Henry, 1922:46, Plate VII, Figures 5, 5a (Chydorus jugosus).

Material. According to description.

Female. Posteroventral corner of valve without denticle. Valve with lines. Rostrum pointed. Antennules ending far before apex of rostrum.

Esthetascs reaching beyond middle of rostrum. Labrum with a narrow lobe directed posteriorly. There are 14–16 anal denticles accompanied by setae. Claws with 2 basal spines. Ocellus slightly smaller than eye, situated near the eye, far from apex of rostrum. Length 0.74 mm.

An inner row of setae on the ventral margin of the valve, a characteristic of Chydorus, has not been described. Without a more detailed study, this species should therefore be placed in the genus Alonella.

Male. Unknown.

Distribution. Southeast Australia.

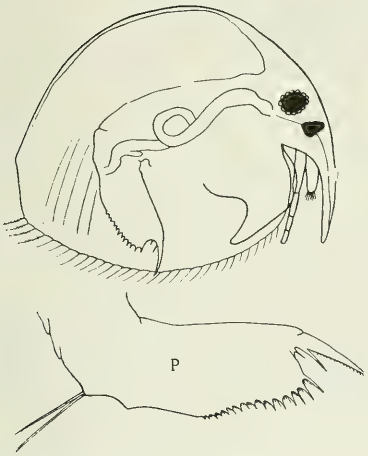

FIGURE 282. Alonella jugosa, female (after Henry, 1922)

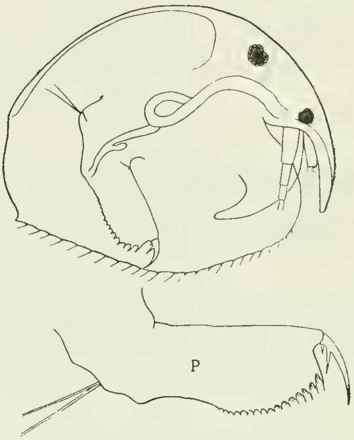

FIGURE 283. Alonella unispina, female (after Henry, 1922)

11. **Alonella unispina** (Henry, 1922) comb. n.

(Figures 275, 283)

Henry, 1922:46, Plate VII, Figures 4, 4a (Chydorus unispinus); Brehm, 1931:498–499, Figures 5, 6.

Material. According to description.

Female. Posteroventral corner of valve with a denticle directed posteriorly. Rostrum pointed. Antennules ending far before apex of rostrum. Plate of labrum oblong, with smooth margin. Postabdomen with distinct anal incisions. Claws curved, with 2 basal spines. Anal denticles in 12–15 groups. Ocellus slightly nearer to eye than to apex of rostrum. Intestine forming loops, with a caecum.

Male. Unknown.

Distribution. Australia, New Zealand.

Species incertae sedis

Alonella brachycopa Brehm, 1931:497–498, Figures 3, 4.

Alonella brasiliensis Bergamin, 1935:284–285, Figures 1, 2.

Alonella excisa var. goplana Dybowski and Grochowski, 1895:152. Nomen nudum.

Alonella excisa var. miraticensis Dybowski and Grochowski, 1895:152. Nomen nudum.

Alonella excisa var. szszorsiana Dybowski and Grochowski, 1895:152. Nomen nudum.

Alonella excisa var. wojnowiensis Dybowski and Grochowski, 1895:152. Nomen nudum.

Alonella fitzpatricki Chien, 1970:532–536, Figures 1, 2, 3.

Alonella leei Chien, 1970:532, 533, 536–538, Figures 4, 5.

Alonella piasti (Dybowski and Grochowski, 1895). Dybowski and Grochowski, 1895:152 (Lynceus piasii). Nomen nudum.

272 Alonella rostrata var. kromanensis (Drybowski and Grochowski, 1895). Dybowski and Grochowski, 1895:151 (Lynceus rostratus var. Kromanensis). Nomen nudum.

6. Genus Disparalona Fryer, 1968

Lilljeborg, 1900:482 (Lynceus, part); Birge, 1910:1049 (subgenus Alonella s. str.); Fryer, 1968:286–287, 294; Smirnov, 1969a:559.

Type species: Disparalona rostrata (Koch, 1841).

Body oblong. Valve with polygons or lines. Rostrum long. Antennules ending more than their own length before apex of rostrum. Antennae with 7 setae and 3 spines. Postabdomen with anal spines and isolated lateral setae.

The exopodite of leg I of D. rostrata bears a single seta; the outer branch of the endite bears 3 setae, the anterior lobe of the inner branch of the endite 4 setae, the posterior lobe 3 setae, and the posterior side of the endite 4 setae. The setae of the soft row on the endite on leg III of D. rostrata are enlarged, in contrast to all other Chydoridae. The setae of the soft row of leg IV are smaller than those of the hard (outer) row. Intestine with a caecum.

Key to Species of the Genus Disparalona according to Females

1 (2). Rostrum directed ventrally. . . . . .1. D. rostrata (Koch, 1841).
2 (1). Rostrum directed posteriorly.
3 (4). Plate of labrum with convex, smooth anterior margin. Preanal corner slightly projecting . . . . 2. D. acutirostris (Birge, 1879).
4 (3). Anterior margin of plate of labrum undulate or with a process. Preanal corner strongly projecting . . . . . 3. D. dadayi Birge, 1910.

1. Disparalona rostrata (Koch, 1841)

Female. Posteroventral corner of valve rounded, with 1–3 denticles or without denticles; right and left valve sometimes with a different number of denticles on the posteroventral corner. Valves with distinct posterodorsal corner. Maximum height in middle of body. Valve with longitudinal lines which are fused in some places. Lines on valve projecting in anterior view (Figure 104). Rostrum long, pointed. Head pores typical for the subfamily. Antennules half length of rostrum. Anterior margin of antennules with a sensory seta closer to distal end. Spines on antennae 1–0–1/0–0–1. Spine on basal segment of endopodite of antenna longer than second segment. Natatorial seta on second segment of exopodite comparatively long, basal segment reaching beyond middle of terminal spine. Plate of labrum with rounded apex.

Postabdomen elongate, with convex dorsal and ventral margin. Distal corner of postabdomen smoothly rounded. There may be a small spinule proximal to the large basal spine. Margin of anus concave, with setae in distal part. Preanal corner not projecting. There are 10–13 anal denticles. Ocellus nearer to eye than to apex of rostrum.

Exopodite and outer branch of endite of leg I situated relatively high (nearer to base of leg). Outer branch of endite of leg I with 2 thin setae of almost equal length and with a hooklike seta one quarter their length.

Anterior lobe of inner branch of endite of leg I with 4 setae, posterior lobe with 3 setae. Posterior side of endite of leg I with 4 setae, one of them bent at right angles to stem of endite.

Endite of leg III divided, the part near the gnathobase with 5 short setae and a sensilla. Part of endite situated far from gnathobase with 3 thin setae; setae 7 and 8 long, seta 6 very small. Endite with 6 large, scattered, soft setae. Setae D, E, and F of the soft row are especially well developed. Adjacent hard setae 7 and 8 very thin, seta 6 small because of suppression by the well developed soft setae (in other species of Chydoridae the soft setae are suppressed by the well developed hard setae). Filtering fan of gnathobase with 8 setae.

Endite of leg IV with 4 hard and 4 soft setae. Filtering fan of gnathobase with 4 setae. Leg V has lobed endite with 2 setae. Remnant of gnathobase present. Filtering fan of gnathobase of leg V with 3 setae. Other characters of legs typical for the genus. Our illustrations of the legs of the female D. rostrata correct those published by Lilljeborg (1900) as follows. Exopodite of leg III with 7 setae; Lilljeborg does not show the two ear-shaped processes above the anterior seta on the exopodite of leg V. Length (12 August 1960) 0.35 (1st stage) to 0.5 mm, minimum length of gravid females 0.39 mm (3rd stage).

Male. Posteroventral corner of valve rounded, with a denticle. Maxi-
273 mum height anterior to middle. Valve with lines which project beyond the surface in anterior view. Antennules not reaching apex of rostrum. Anterior margin of antennules distally with a sensory seta and even more distally with a 2-segmented flagellum. Esthetascs terminal, one of them subterminal on posterior margin of antennule. Postabdomen tapering distally. Anal spinules absent. Groups of lateral setae present. Preanal corner not projecting. Claws without basal spines. Leg I with a hook and a group of setae opposite the apex of the hook. Outer branch of endite with 3 setae of slightly different length. Exopodite of leg I with a seta which is longer than the longest seta on the outer branch of the endite. Van deferens opening at base of claws, ventral to them. Length to 0.45 mm.

Juvenile male. Postabdomen resembling that of female. Claw with a basal spine. Length 0.37 mm.

Biology. Inhabits the open littoral.

Key to Subspecies of D. rostrata

1 (2). Valves with pattern of polygons but without tubercles . . . . 1a. **D. rostrata rostrata** (Koch, 1841).

2 (1). Valves with pattern of polygons and tubercles . . . . 1b. **D. rostrata tuberculata** (Herr, 1917).

1a. Disparalona rostrata rostrata (Koch, 1841) (Figures 284–287)

Koch, 1841:36, Plate 12 (Lynceus rostratus); Fischer, 1854:430–431, Plate III, Figures 17–20 (L. griseus); P.E. Müller, 1867:182–183, Plate IV, Figure 12 (Alona); Kurz, 1875:66, Plate II, Figure 7 (Alonella rostrata); Dybowski and Grochowski, 1898a (Lynceus nargielewiczii syn.n. Synonymized after examination of the type, one female from the western Ukraine and deposited in the Zoological Museum of L'vov State University); Weltner, 1899:9 (Alonella neumanni); Lilljeborg, 1900:482–487, Plate LXIX, Figures 7–21 (Lynceus rostratus); Bening, 1941:272–274, Figure 112 (Rhynchotalona rostrata); Frey, 1959:38, Figures 47, 48 (Alonella rostrata); 1961b:129–138, Plate I; 1962a, Figures 47, 48 (Alonella rostrata); Šrámek-Hušek et al., 1962:350–352, Figure 130 (Rhynchotalona rostrata); Herbst, 1962:92, Figure 74 (Alonella rostrata); Sebestyén, 1965:207–210, Plate 5 (Alonella rostrata); Negrea, 1966a:145–146 (Alonella rostrata); Fryer, 1968:287–295, Figures 56–61; Smirnov, 1969a:549–559, Figures 1, 5, 9, 10, and 11.

Material. Numerous females from the Volga reservoirs of Uglich, Cherepovets, Kama, and Volgograd, the Pechora River, the Kalinin pond in the Perm Region, ponds in the Yakot' fish farm, the Amur basin. One female from Lake Muolan-Yarvi (Karelian Isthmus). One female from the Ket' River, western Siberia. One female from a pond in the Kalgan-Chirchik fish farm near Tashkent. One female from the western Ukraine. Numerous males from the Rybinsk Reservoir. One female from a pond near Omsk. Preparations: MGU – females 611, 656, male 1975, juvenile males 1988, 1660. ZIN – female 53885 (320), male 53886 (1951). Ph – female 402, male 1923.

Female. Valve reticulate but without tubercles.

Distribution. Holarctic Region.

1b. Disparalona rostrata tuberculata (Herr, 1917) (Figure 288)

Herr, 1917:112 (Rhynchotalona rostrata var. tuberculata).

Material. Females from Bol'shoi Tabisan (Amur basin). Preparation: MGU – female 1081.

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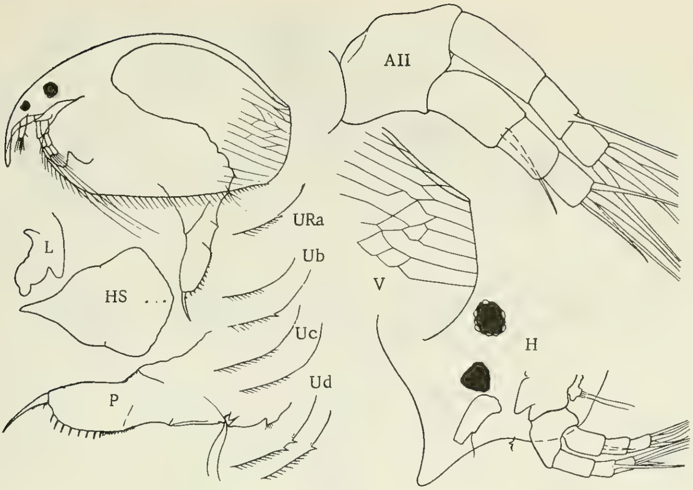

FIGURE 284. Disparalona rostrata rostrata, female, length 0.48 mm (Il'd River, 10 August 1962):

CRa – Lake Karga, Chita Region, 18 July 1964; Cb, Cc, Cd – variation in denticles on posteroventral corner of valve; L – labrum (Uglich Reservoir, 23 July 1962); HS – after Frey, 1962a; P – Il'd River, 10 August 1962; AII – left antenna (Uglich Reservoir, 23 July 1962); V – Volgograd Reservoir, 26 July 1961, preparation 611; H – head, ventral (Pechora River, 4 August 1962).

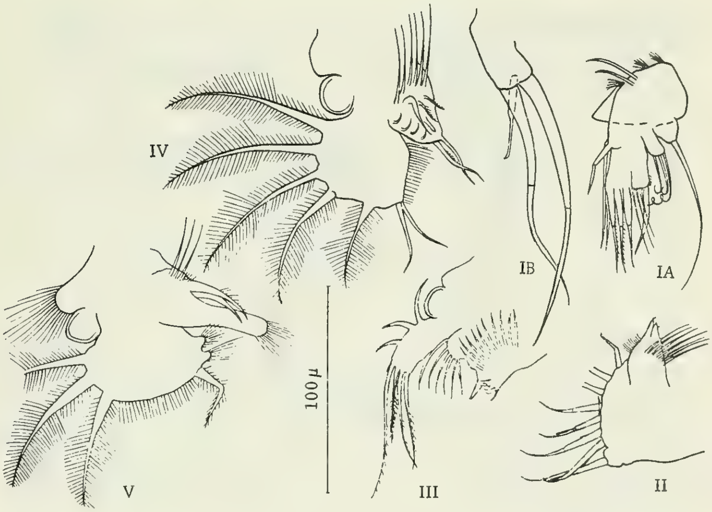

FIGURE 285. Legs of female of Disparalona rostrata rostrata (Uglich Reservoir, 23 July 1962):

IA – left leg, anterolateral; IB – outer part of endite of left leg I, lateral; II, IV, V – left legs, inner side; III – right leg, inner side.

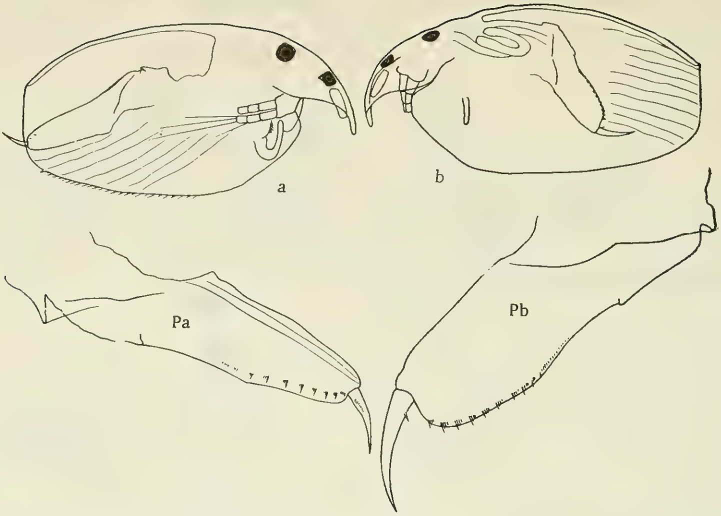

FIGURE 286. Disparalona rostrata rostrata:

a – adult male, length 0.38 mm (Omsk, pond, 13 September 1964, preparation 1660); Pa – postabdomen; b – juvenile male, length 0.37 mm (Rybinsk Reservoir, Borok, 15 September 1965, preparation 1988); Pb – postabdomen.

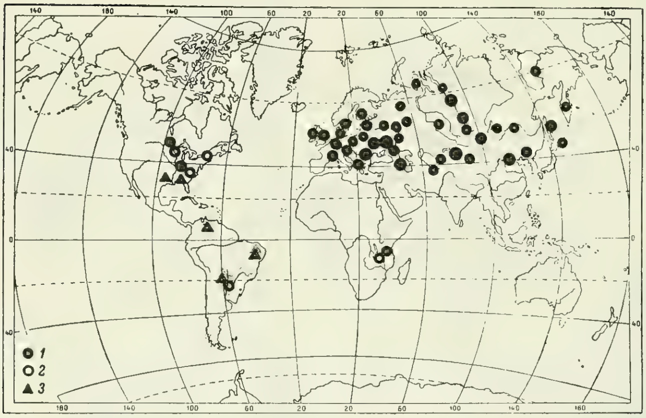

FIGURE 287. Distribution:

1 – Disparalona rostrata rostrata; 2 – D. acutirostris; 3 – D. dadayi.

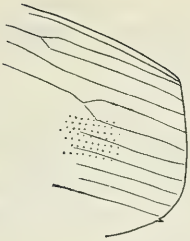

FIGURE 288. Disparalona rostrata tuberculata, female. Bol'shoi Tabisan, Amur basin, 29 July 1959, preparation 1081. Sculpture of valve.

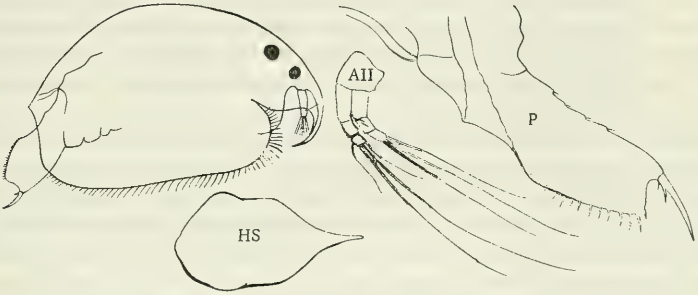

FIGURE 289. Disparalona acutirostris, female, right side, after Birge, 1879: HS — after Frey, 1962a; P — after Daday, 1905; AII — after Frey, 1961a.

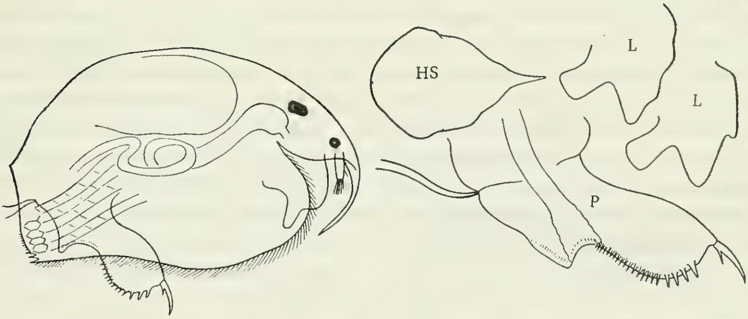

FIGURE 290. Disparalona dadayi, female, right side: L, P — after Daday, 1905; HS — after Frey, 1962a.

Female. Valves with rows of tubercles.

Distribution. Central Europe, Volga delta, Bol'shoi Tabisan (Amur basin).

2. Disparalona acutirostris (Birge, 1879) (Figures 287, 289)

Birge, 1879:23, Plate II, Figure 15 (Pleuroxus); 1893:305 (Alonella rostrata); Daday, 1905:169–170, Plate X, Figures 24, 25 (Leptorhynchus rostratus); Birge, 1918:736, Figure 1162 (Alonella rostrata); Frey, 1959:38, Figures 40, 40a (Alonella).

Material. Two females from Sebago Lake in Maine, U.S.A. Preparation: MGU – 2 females, 2518.

Female. Valve with distinct posterodorsal corner and rounded posteroventral corner. Maximum height in the middle. Valve reticulate. According to Brooks (1959), valves with longitudinal lines. Posteroventral corner of valve with or without denticle. Rostrum long, pointed, curved posteriorly. Head pores typical for the subfamily. Setae on antennae: 0–0–3/0–1–3 (Frey, 1961b). Spine on proximal segment of antennal endopodite about as long as second segment. Second segment of exopodite with relatively short natatorial seta; basal segment of exopodite not reaching middle of terminal spine.

276 Postabdomen wide, with anal denticles and lateral setae. Proximal anal denticles accompanied by small setae. Preanal corner distinct but not strongly projecting. Claws with 2 basal spines, proximal spine smaller. Length of larger basal spine of claw equal to basal width of claw. Ocellus situated much nearer to eye than to apex of rostrum. Length 0.5 mm.

Male. Length 0.4 mm.

Distribution. Africa, North and South America.

277 3. Disparalona dadayi Birge, 1910 (Figures 287, 290)

Daday, 1905:168–169, Plate X, Figures 18–23 (Leptorhynchus dentifer); Birge, 1910:1052 (Alonella); Frey, 1959:38, Figure 44, 1962a, Figure 44 (Alonella); Goulden, 1966b:103–104 (Alonella).

Material. According to description.

Female. Valves with distinct posterodorsal corner; posteroventral corner with one or several denticles. Valves reticulate. Rostrum long, pointed, curved posteriorly. Head pores typical for the subfamily. Antennules spindle-shaped, $^1/_4$ length of rostrum. Antennae with 7 setae. Plate of labrum with undulate anterior margin. Postabdomen with strongly projecting preanal corner. Dorsal margin of postabdomen rounded distally. Claws with one basal spine which is less than half length of the claw. Intestine forming loops. Ocellus nearer to eye than to apex of rostrum. Length to 0.45 mm.

Male. Length 0.2 mm.

Distribution. North and South America.

7. Genus Chydorus Leach, 1816

Schrank, 1781:536 (Monoculus part); O. F. Müller, 1785:71 (Lynceus part); Leach, 1816:406; Baird, 1843:89 (subgenus Chydorus); Schoedler, 1862:11–12; 1863:11–12; Kurz, 1875:76–77; Hellich, 1877:107–108; Herrick, 1884:115; Stingelin, 1895:260; Lilljeborg, 1900:545–547; Sars, 1901:66–67; 1916:339; Daday, 1910b:121; Bergamin, 1939:89–90; Bening, 1941:325; Šrámek-Hušek, et al., 1962:348–350, 385, 414 (Chydorus, Paralona); Herbst, 1962:100.

Type species: Chydorus sphaericus (O. F. Müller, 1785). Posterior part of ventral margin of valves with setae on inner surface of valve. Antennules of female not reaching apex of rostrum. Setae on antennae: 0–0–3/0(1)–1–3. Postabdomen with anal denticles. Claws of female with 2 basal spines. Head shield with 2 separate main pores and 2 small pores between them (Frey, 1959, 1962a). Head pores apparently absent in Chydorus barroisi. They are absent also in Ch. hybridus and Ch. poppei (Frey, 1965). Intestine with a caecum. Ocellus smaller than eye, except in Ch. gibbus and Ch. piger.

Five pairs of legs in the species examined. Leg I with rows of setules on anterior surface of endite. Distal part forming an exopodite with a long seta. Endite with outer and inner branch, the latter divided into an anterior and posterior lobe. Outer branch of endite with 3 setae in the female. These setae are different in form in the male. Leg II with an endite with 8 chitinized setae on the posterior margin. These setae differ from each other more distinctly in Ch. gibbus than in other species. Row of soft setae on endite absent. Gnathobase narrow, with a row of filtering setae. Leg III with a large exopodite with 4 setae on the posterior side and 3 setae on the dorsal side. The longest seta at most double exopodite. Ch. eurynotus has relatively long setae on the dorsal side of the exopodite. Anterior seta on posterior side sparsely pubescent. Endite with long setae near the exopodite. Gnathobase with a row of filtering setae. Leg IV with a very large exopodite with 7 large setae, the anterior setae shorter than the others. Middle seta more distinctly defined from lobe of exopodite. Anterior seta sparsely pubescent. Gnathobase with a row of filtering setae. Leg V with a very large exopodite with 3 setae on the posterior side and one seta on the anterior side. There are two distinct pubescent processes above the anterior seta in Ch. gibbus. Observations show that the outer branch of the endite of leg I with its chitinized setae serves for movement on the substrate. The outer branch of the endite of the male bears a hook for attachment to the valves of other individuals.

The inner branch of the endite of leg I with its row of feathered setae covers leg II anteroventrally and prevents food collected by leg II from falling off. Leg II collects food with the chitinized endite and its chitinized setae. The fan of feathered setae on the gnathobase of leg II unites with the fans on the gnathobase and endite of legs III, IV, and V in a row which closes the spaces between the legs. Such a row is present on the right and left side; its function is to hold the food brought there by the endite of leg II. The feathered setae which form these rows are directed toward the ventral side of the body and form a filtration chamber closed ventrally by the endites of legs III–V. Rhythmical, almost continuous movements of the exopodites of legs IV and V create a water current posteriorly which filters off excess water entering the filtration chamber together with the food. The exopodite of leg III does not move rhythmically but probably directs the water current, as it is situated anteriorly and ventral to the water-pumping lobes of the exopodites of legs IV and V.

The genera Pleuroxus, Alonella, and Chydorus resemble each other so closely in the morphology of the legs that it is difficult to define a structure of the legs characteristic of the genus Chydorus.

Males are distinguished by the modified postabdomen and the structure of leg I.

278 Key to Species of the Genus Chydorus according to Females

1 (38). Postabdomen with parallel dorsal and ventral margin.
2 (35). Valves without deep polygonal cells.
3 (26). Plate of labrum with pointed apex.
4 (19). Anterior margin of labrum without denticles.
5 (18). Dorsal margin of carapace uniformly curved.
6 (17). Ventral margin of valve uniformly curved.
7 (16). Posteroventral corner of valve without denticles.
8 (13). Valves without undulate lines.
9 (12). Valves with pattern of polygons with straight borders, or without polygons.
10 (11). Anterior margin of antennules with a sensory seta .... 1. **Ch. sphaericus** (O. F. Müller, 1785).
11 (10). Anterior margin of antennule with a sensory seta and a sensory papilla .... 2. **Ch. ovalis** Kurz, 1875.
12 (9). Valves with pattern of polygons with undulate borders .... 3. **Ch. herrmanni** Brehm, 1933.
13 (8). Valves with undulate lines.
14 (15). Postabdomen with 10–12 anal denticles and strongly narrowing distal to the anus .... 4. **Ch. pigroides** Lilljeborg, 1900.
15 (14). Postabdomen with 8–9 anal denticles which pass proximally into a long row of setae, slightly narrowing distal to the anus .... 5. **Ch. piger** Sars, 1862.
16 (7). Posteroventral corner of valve with a denticle .... 6. **Ch. nitidulus** (Sars, 1901) comb. n.
17 (6). Ventral margin of valve with a convexity in the middle .... 7. **Ch. ventricosus** Daday, 1898.
18 (5). Carapace with humped dorsal margin . . . 8. **Ch. gibbus** Sars, 1891.
19 (4). Anterior margin of labrum with one or several denticles.
20 (25). Anterior margin of labrum with several denticles.
21 (24). Plate of labrum with distinct denticles.
22 (23). Anal denticles on postabdomen of markedly different length, those near the anus much longer than the others .... 9. **Ch. barroisi** (Richard, 1894).
23 (22). Anal denticles on postabdomen of only slightly different length, large denticles near the anus only slightly longer than the others .... 10. **Ch. phintonicus** Margaritora, 1969.

24 (21). Plate of labrum with little developed denticles; therefore with steplike anterior margin . . . . 11. **Ch.** poppei Richard, 1897.
25 (20). Anterior margin of labrum with a single denticle . . . . 12. **Ch. hybridus** Daday, 1905.
26 (3). Plate of labrum with rounded apex.
27 (34). Dorsal side of valves not pubescent.
28 (33). Posteroventral corner without denticles.
29 (32). Valves without chitinous knobs on inner side of anterior margin.
30 (31). Labrum with slightly produced apex. Postabdomen not tapering distally . . . . 13. **Ch.** eurynotus Sars, 1901.
31 (30). Labrus broadly rounded. Postabdomen slightly tapering distally . . . . 14. **Ch.** kallipigos Brehm, 1934.
32 (29). Valves with 1–3 chitinous knobs on inner side of anterior margin . . . . 15. **Ch.** parvus (Daday, 1898).
33 (28). Posteroventral corner with denticles . . . . 16. Ch. dentifer Daday, 1905.
34 (27). Dorsal side of valves pubescent . . . . 17. Ch. ciliatus Poggenpol, 1874.
35 (2). Valves with deep polygonal cells.
36 (37). Valves without crests or lateral horn . . . . 18. **Ch.** faviformis Birge, 1893.
37 (36). Valves with crests and lateral horn . . . . 19. Ch. **bicornutus** Doolittle, 1909.
38 (1). Postabdomen tapering at the end.
39 (40). Labral plate with denticle . . . . 20. **Ch. brevidentatus** N. N. Smirnov sp. n.
40 (39). Labral plate without denticle.
41 (42). Apex of rostrum not reaching apex of antennules . . . . 21. **Ch. breviceps** (Stingelin, 1905) comb. n.
42 (41). Apex of rostrum extending beyond apex of antennules,
43 (44). Postabdomen trapezoidal, with truncate distal margin. Groups of lateral setae extending across postabdomen . . . . 22. Ch. carolinae Methuen, 1910.
44 (43). Postabdomen triangular, dorsal and ventral margin converging toward base of claws . . . . 23. Ch. godeti Delachaux, 1919.

279 Key to Known Males of the Genus Chydorus

1 (14). Postabdomen tapering in postanal part.
2 (13). Postabdomen strongly tapering in postanal part.
3 (10). Postabdomen with swollen apex.
4 (5). Anal denticles absent (except in Ch. sphaericus patagonicus in which about 14 anal denticles are present. . . 1. Ch. sphaericus.
5 (4). Anal denticles present.
6 (7). A single anal denticle . . . . 3. Ch. herrmanni.
7 (6). Several anal denticles.
8 (9). Anal denticles short, numerous . . . . 8. Ch. gibbus.
9 (8). Anal denticles long, 6 in number . . . . 15. Ch. parvus.
10 (3). Postanal part of postabdomen with parallel dorsal and ventral margin.

11 (12). About 10 anal denticles . . . . 4. Ch. pigroides.
12 (11). Five anal denticles . . . . 17. Ch. ciliatus.
13 (2). Postabdomen gradually tapering in postanal part . . . 5. Ch. piger.
14 (1). Postabdomen not tapering in distal part.
15 (18). Postabdomen not widened distally.
16 (17). Plate of labrum with curved anterior margin. Vas deferens ventral to the claws . . . . 2. Ch. ovalis.
17 (16). Plate of labrum with serrated anterior margin . . . 9. Ch. barroisi.
18 (15). Postabdomen widening distally . . . . 13. Ch. eurynotus.

1. Chydorus sphaericus (O. F. Müller, 1785)

The subspecies are not distinguished in the following publications: Schrank, 1781:536 (*Monoculus infusorius*); King, 1853:258–259, Plate VIIc (*leonardi*); Lilljeborg, 1900:562–563 (*minor*); Frey, 1959:40, Figure 63; 1962a, Figure 63; Herbst, 1962:103; Manuilova, 1964:226–227, Figure 112; Negrea, 1966a:148–149; Fryer, 1968:348–362, Figures 120–128, 136.

Female. Length of body slightly more than height. Valve with distinct posterodorsal corner. Posteroventral corner rounded, without denticles. Reticulation of valves usually consisting of pentagonal-hexagonal cells or of tubercles and grooves; valves sometimes smooth. Valves with undulate lines inside the polygons; under high magnification these lines are shown to consist of fine dots (Scourfield, 1924). Tubercles frequently present on borders of polygons (Frey, 1960). Rostrum pointed. Posterior margin of head shield rounded. Head pores typical for the subfamily. Antennules with a sensory seta near middle of anterior margin. All esthetascs situated on apex of antennule. Setae on antennae: 0–0–3/0–1–3. Plate of labrum with smooth, convex margin, with produced, pointed apex.

Postabdomen short. Proximal corner of anus projecting, situated nearer to the natatorial setae than to the base of the claws. There are 7–10 anal denticles. Lateral setae present. Claw with setae on the concave margin.

Legs typical for the genus. Outer branch of endite of leg I with 3 setae, 2 of them of about equal length, the third hook-shaped and slightly more than half this length. Hard setae on endite of leg III arranged in 2 groups, one of them consisting of setae 6, 7, and 8 (seta 6 small), the other group consisting of setae 1–5. Setae 1–4 curved, seta 5 straight and shorter than the others. Endite of leg III with 7 soft setae. Gnathobase with filtering fan of 8 setae.

Ephippial females resemble *Pseudochydorus globosus* because of the dark spot in the ephippial area; in such cases, the determination should be based on other characters. Ocellus nearer to eye than to apex of rostrum. Length, according to material from the Rybinsk Reservoir (May 1960), from 0.27 (1st stage) to 0.52 mm; minimum length of gravid females 0.3 mm (3rd stage).

Male. Valve with distinct posterodorsal corner. Posteroventral corner rounded, without denticles. Rostrum blunt, head shield with rounded posterior margin. Antennules with 2-segmented flagellum in middle of anterior margin; sensory seta situated proximal to the flagellum. Twelve sensory papillae (Scourfield, 1898). Plate of labrum with a pointed apex. Postabdomen wide at the base, tapering distally. Anus with projecting proximal corner. Claw with a basal spine and with setae on the concave margin. Outer branch of endite of leg I with 4 setae (2 setae shorter, 2 longer) and a hook. Ocellus situated halfway between eye and apex of rostrum. Vas deferens opening dorsally at base of claws. Length to 0.36 mm. Postabdomen of juvenile male resembling that of female (Lilljeborg, 1900, Plate LXXVII, Figure 19).

The numerous subspecies, distinguished especially by the degree of development of the groups of lateral setae on the postabdomen, may be considered as flourishing or suppressed populations to a varying degree or the result of intensive speciation in the new pelagial environment.

280 Biology. Lives in or outside the vegetation; in contrast to other Chydoridae, it lives in the pelagial if planktonic algae are present. Monocyclic at vegetation periods of up to 7 months, dicyclic at longer vegetation periods (Vereshchagin, 1912b).

Key to Subspecies of Ch. sphaericus according to Females

1 (16). Valves not pitted.
2 (13). Valves indistinctly reticulate, without dots. Length to 0.8 mm.
3 (12). Apex of plate of labrum not produced into a rodlike process.
4 (7). Postabdomen with groups of lateral setae in a single row.
5 (6). Numerous lateral setae in each group. Postabdomen of male without anal denticles .... 1a. **Ch. sphaericus sphaericus** (O. F. Müller, 1785).
6 (5). A few lateral setae in each group. Postabdomen of male with anal denticles .... 1b. **Ch. sphaericus patagonicus** Ekman, 1900.
7 (4). Postabdomen with groups of lateral setae in 2 or several rows.
8 (9). Groups of lateral setae in 2 rows .... 1c. **Ch. sphaericus pectinatus** Delachaux, 1919.
9 (8). Groups of lateral setae in more than 2 rows.
10 (11). Groups of lateral setae in 3 rows in some places .... 1d. **Ch. sphaericus latus** Sars, 1862 comb. n.
11 (10). Groups of lateral setae on the whole postabdomen .... 1e. **Ch. sphaericus plumatus** Löffler, 1961.
12 (3). Apex of plate of labrum produced into a rodlike process .... 1f. **Ch. sphaericus mutilus** Kreis, 1921.
13 (2). Valves distinctly reticulate or punctate. Length 0.38 mm.
14 (15). Valves punctate, without reticulation .... 1g. **Ch. sphaericus nitidus** Schoedler, 1862.
15 (14). Valves reticulate .... 1h. **Ch. sphaericus alexandrovi** Poggenpol, 1874.
16 (1). Valves pitted ..... 1i. **Ch. sphaericus caelatus** Schoedler, 1862.

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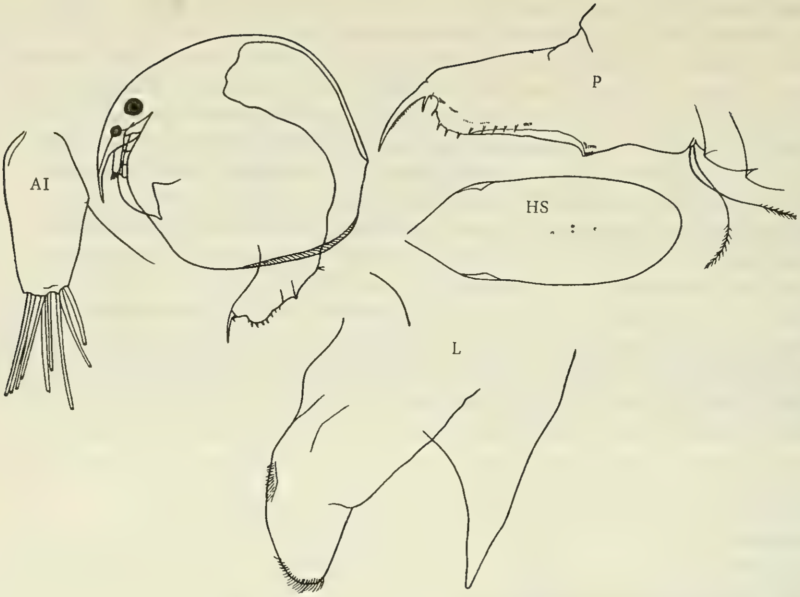

FIGURE 291. Chydorus sphaericus sphaericus, female, length 0.4 mm (Rybinsk Reservoir, 13 June 1961):

AI — right antennule, outer side; P — Rybinsk Reservoir, Bor-Timonino, 13 June 1961; HS — puddle near the river Kotinka (Bol'shie Koty, Baikal coast), 22 August 1964, preparation 1634.

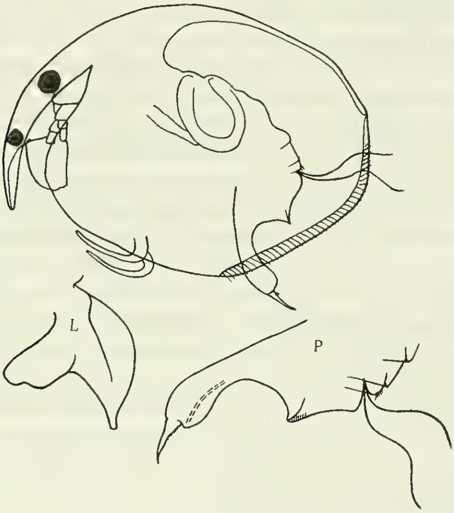

FIGURE 292. Chydorus sphaericus sphaericus, male, length 0.41 mm (Rybinsk Reservoir, 18 September 1962)

1a. **Chydorus sphaericus sphaericus** (O. F. Müller, 1785)
(Figures 291–293)

O. F. Müller, 1776:199 (Lynceus); 1785:71–72, Plate IX, Figures 7, 8, 9 (Lynceus); Linné, 1788:3008 (Monoculus); Leach, 1816:406; Jurine, 1820:157–158, Plate 16, Figures 31–m (Monoculus); Edwards, 1840, Plate 3:386–387 (Lynceus); Baird, 1843:89–90, Plate II, Figures 11–13; 1850:126; Zaddach, 1844:29 (Lynceus); Bening, 1851:192, Plate IX, Figures 13, 14, 15 (Lynceus); King, 1853:258, Plate VIIc (leonardi); Schoedler, 1862:12–13, Plate I, Figures 3–7; P. E. Müller, 1867:194–195; Plate IV, Figure 24; Sars, 1891:49 (minor); Stingelin, 1895:262–265, Plate VIII, Figures 46, 47, 48; Lilljeborg, 1900:561–567, Plate 77, Figures 8–25 (sphaericus), 565 (minor); Langhans, 1911:47 (lynceus syn.n.); Bening, 1941:330–333, Figure 137; Šrámek-Hušek et al., 1962:394 (var. sphaericus).

(282)

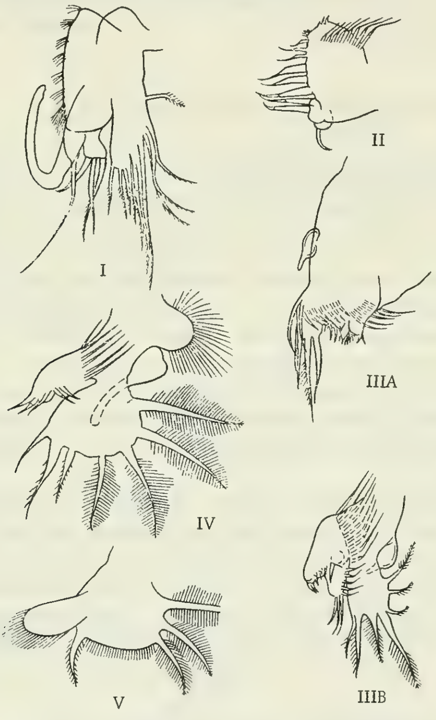

FIGURE 293. Legs of male of Chydorus sphaericus sphaericus:

I – left leg, outer view; II – left leg, inner view; IIIA – right leg, ventral; IIIB, IV – right legs, inner view; V – right leg, inner view.

Material. Numerous females from the Volga reservoirs of Ivan'kovo, Uglich, Gorki, and Kuibyshev, ditches near the Moscow River, peat quarries near Lake Poletskoe in Moscow Region, the Komi ASSR, the Vashutkinye lakes in the Arkhangelsk Region, ponds in the Perm Region, ponds and rivulets in the Crimea, the Lenkoran' district, lakes near Orenburg, Lake Issyk-Kul', ponds in the Omsk Region. Elovskii pond near the Angara River in the Irkutsk Region, Lake Kadil'noe on the shore of Lake Baikal north of Bol'shie Koty, rivulets and puddles in Bol'shie Koty, the Amur basin, Lake Kronotskoe in Kamchatka, Lake Karagel in Turkey, and New South Wales and Queensland, Australia. One female from Achishko in the Caucasus. Numerous males from the Rybinsk and Cherepovets reservoirs and from the Vashutkinye lakes in the Arkhangel'sk Region.

Female. Valve smooth or weakly reticulate, without pits or dots. Anterior margin of head without depressions. Lateral setae of postabdomen in several groups arranged in a single row. Plate of labrum with pointed but not produced apex. There are 7–10 anal denticles. Length to 0.5 mm.

Distribution. Cosmopolitan, but not reported so far from New Zealand and Antarctica.

1b. Chydorus sphaericus patagonicus Ekman, 1900
(Figures 294, 295)

Ekman, 1900:81–82, Plate 4, Figures 31, 32, 33 (patagonicus); Sars, 1909:19–21, Plate II, Figures 12–16 (sphaericoides syn.n.).

Material. According to description.

Female. Valves with distinct posterodorsal corner. Posteroventral corner rounded. Valves without reticulation. Valves with 3–4 lines parallel to the ventral margin and connected in some places by transverse lines. Preanal corner with a group of setae. About 12 anal denticles,
282 some of them irregularly distributed, 2 groups of setae proximal to them. Lateral setae present. Claws with 2 basal spines, proximal spine smaller. Ocellus smaller than eye, situated nearer to the eye than to apex of rostrum. Length to 0.57 mm.

Male. Dorsal margin less convex, ventral margin more convex than in female. Rostrum blunt. Antennules projecting beyond apex of rostrum. Anterior margin of antennule with a small and a large sensory seta. Postabdomen with narrow distal part. Anal denticles present. Ocellus situated halfway between eye and apex of rostrum. Length to 0.34 mm.

Distribution. Southern part of South America, Falkland Islands.

1c. Chydorus sphaericus pectinatus Delachaux, 1919
(Figures 296, 297)

Delachaux, 1919:33, Plate III, Figures 12, 13.

Material. Numerous females from the Gorki Reservoir.

Female. Postabdomen with 2 rows of groups of lateral setae. Length of female to 0.43 mm.

Distribution. Peru; a similar form was found in the Gorki Reservoir.

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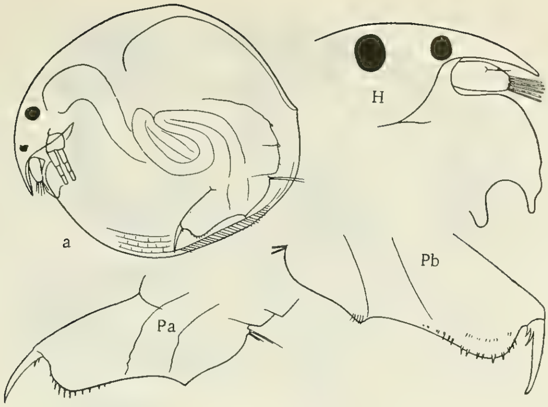

FIGURE 294. Chydorus sphaericus patagonicus, female:
H — after Ekman, 1900; a — after Sars, 1909; Pa — after Sars, 1909; Pb — after Ekman, 1900.

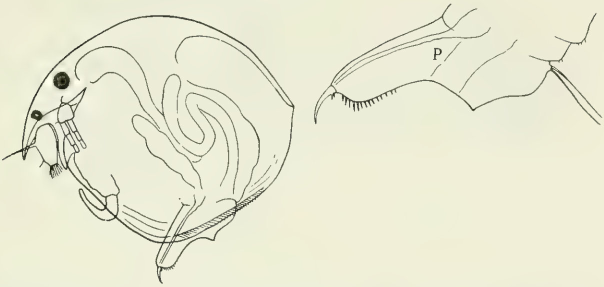

FIGURE 295. Chydorus sphaericus patagonicus, male (after Sars, 1909)

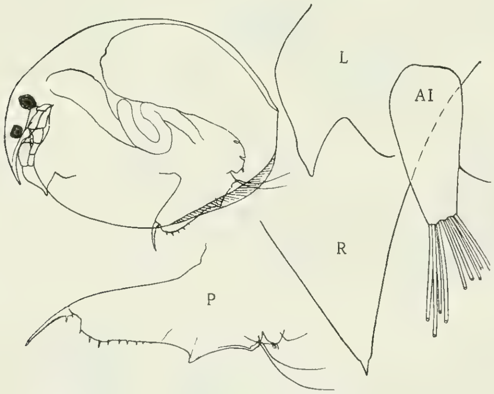

FIGURE 296. Chydorus sphaericus pectinatus, female, length 0.41 mm (Gorki Reservoir, 24 August 1961):
AI, R — left antennule and apex of rostrum, ventral.

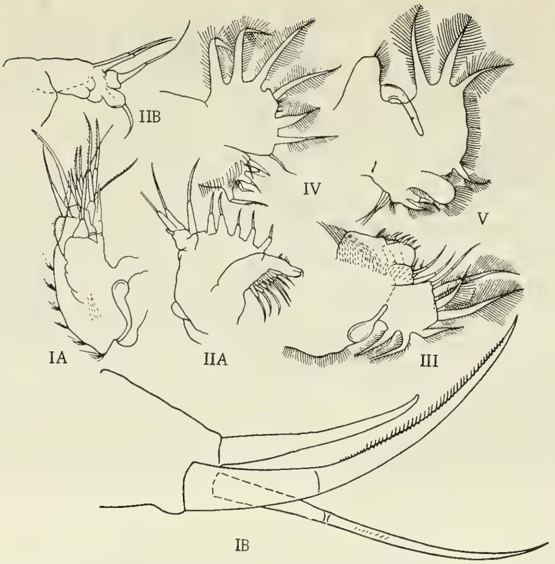

FIGURE 297. Legs of female of Chydorus sphaericus pectinatus, right side (Gorki Reservoir, 24 August 1961):

IA, IIA, III, IV — outer side; IB — outer branch of endite posteriorly; IIB — ventrally; V — inner side.

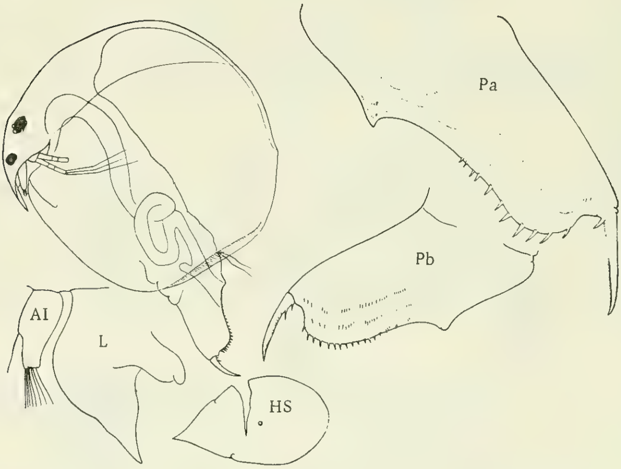

FIGURE 298. Chydorus sphaericus latus, female, left side:

AI, L — after Lilljeborg, 1900; HS — after Frey, 1962a; Pa — after Stingelin, 1895; Pb — after Stenroos, 1897.

(285)

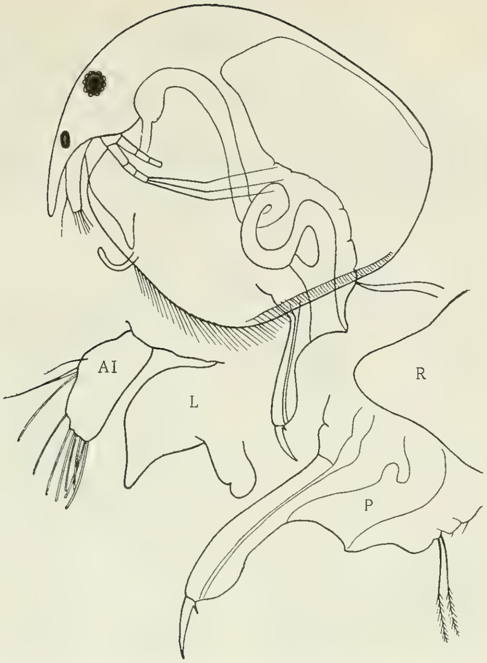

FIGURE 299. Chydorus sphaericus latus, male (after Lilljeborg, 1900)

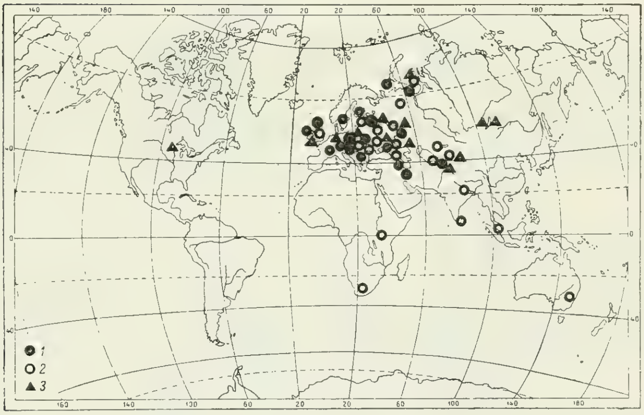

FIGURE 300. Distribution:

1 – Chydorus sphaericus latus; 2 – Ch. sphaericus alexandrovi; 3 – Ch. sphaericus caelatus.

1d. **Chydorus sphaericus latus** Sars, 1862 comb. n.
(Figures 298–300)

Sars, 1862b:289–290 (latus); Stingelin, 1895:261–262, Plate VIII, Figures 43, 44, 45; Lilljeborg, 1900:557–560, Plate LXXVI, Figures 18, 19, Plate LXXVII, Figures 1–7 (latus); Bening, 1941:333–335, Figure 139 (latus); Frey, 1959:40, Figure 65 (latus); 1962a, Figure 65 (latus); Šrámek-Hušek et al., 1962:395–397, Figure 149B–F (latus); Herbst, 1962:103, Figure 90 (latus); Negrea, 1966a:150.

Material. According to description.

Female. Valve without reticulation. Antennules with a sensory seta distal to middle of anterior margin. Antennae with 7 setae. Proximal 286 segment of endopodite with a spine. Labrum with convex ventral side and pointed posterior process. Postabdomen short. Anus with protruding proximal corner. There are 10–12 anal denticles. Groups of lateral setae arranged in 3 rows near anus. Claws with setae on convex margin. Ocellus nearer to eye than to apex of rostrum. Length to 0.66 mm.

Male. Antennules reaching apex of rostrum. Middle of anterior margin with a 2-segmented flagellum and a sensory papilla; a sensory seta further proximally. Postabdomen strongly narrowing distal to the anus. Anus with protruding proximal corner. Dorsal distal margin without armature. Claw with one basal spine. Ocellus nearer to eye than to apex of rostrum. Vas deferens opening at the base of claws. Length 0.5 mm.

Distribution. Palearctic, European USSR to 75°E in the east.

1e. **Chydorus sphaericus plumatus** Löffler, 1961 (Figure 301)

Löffler, 1961b:164–165, Figures 61, 62, 63 (var. plumatus).

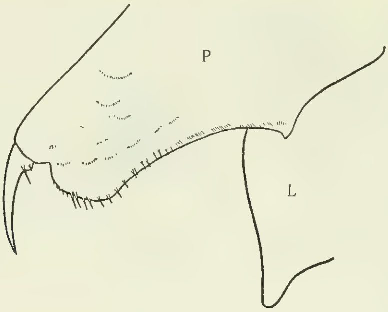

FIGURE 301. Chydorus sphaericus plumatus, female, postabdomen and plate of labrum (after Löffler, 1961a)

Material. According to description.

Female. Valve with pattern of polygons. Postabdomen with up to 12 groups of setae on the lateral surface. There are 12–15 anal denticles, 287 distal denticles thin and long, proximal denticles shorter; groups of setae behind the denticles. Claws with 2 basal denticles. Length 0.55 mm.

Distribution. Chile.

1f. **Chydorus sphaericus mutilus** Kreis, 1921 (Figure 302)

Kreis, 1921:279, Plate X, Figures 42–45 (mutilus); Brehm, 1934b:320–321, Figures 1b, c.

(286)

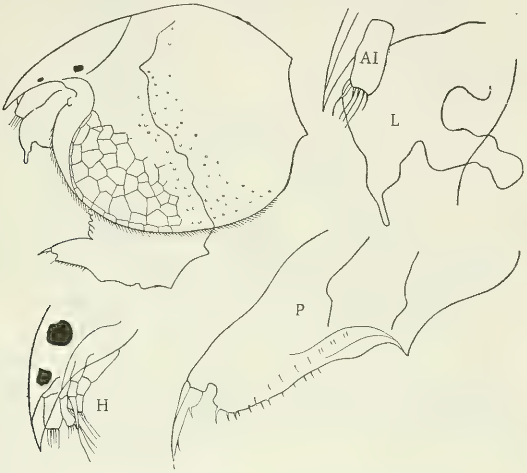

FIGURE 302. Chydorus sphaericus mutilus, female (after Kreis, 1920)

Female. Ratio of height to length 1:1.2. Plate of labrum narrowing apically. Brehm (1934b) found transitions from the typical plate of the labrum to a plate with strongly produced apex in the same population. Valve granulate with tetragonal-pentagonal cells only in the anterior part. Rostrum short. Ten anal denticles. Several setae near the anus.

Distribution. Central Europe.

1g. **Chydorus sphaericus nitidus** Schoedler, 1862 (Figure 303)

Schoedler, 1858:27 (nitidus, without description or drawings); 1862:14–15, Plate I, Figures 1–4 (nitidus); 1863:14, Plate I, Figures 1–4 (nitidus).

Material. According to description.

Female. Valve punctate. Postabdomen with 10–12 anal denticles. Ocellus nearer to eye than to apex of rostrum. Length 0.25 mm.

Distribution. Central Europe.

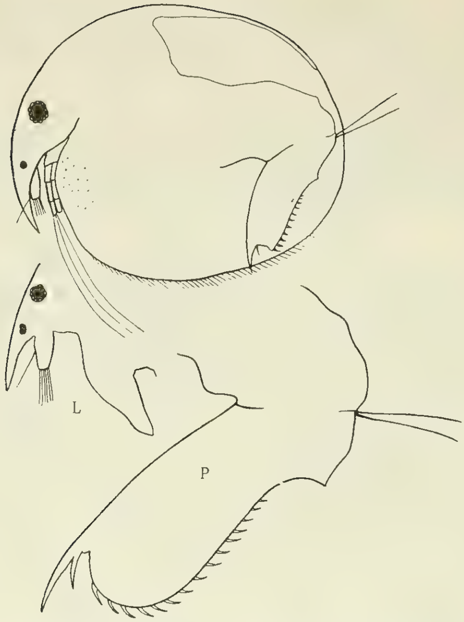

FIGURE 303. Chydorus sphaericus nitidus, female (after Schoedler, 1863)

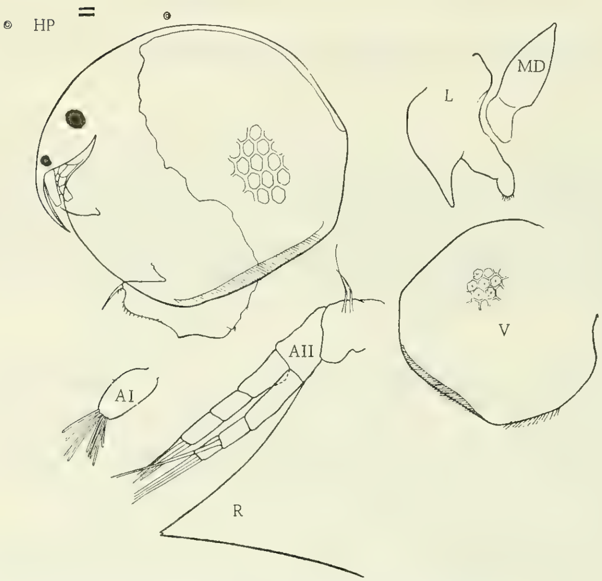

FIGURE 304. Chydorus sphaericus alexandrovi, female (Lake Diyaty, Vashutkiny Lakes, Arkhangel'sk Region, 18 July 1961, preparation 1529):

AI — left antennule; AII, R — left antennule, ventral, and apex of rostrum.

1h. **Chydorus sphaericus alexandrovi** Poggenpol, 1874
(Figures 300, 304, 305, 306)

Poggenpol', 1874–1875:77, Plate XVI, Figure 29, Plate XVII, Figure 8 (alexandrovii); Bening, 1941:333, Figure 138a (alexandrovii); Šrámek-Hušek et al., 1962:394 (var. leonardi); Smirnov, 1966c:Figure 17.

Material. Numerous females from lakes in the Karelian Isthmus, the Vashutkiny lakes in the Arkhangel'sk Region, the Sredne-Vezhinskii pond in the Perm Region, a pond near Omsk, and water bodies in the Terek delta. Two females from the Kyzyl kum. Several females from Lake Issyk-Kul'. Several females from Lake Akzhar in the Dzhambul Region, southern Kirghizia, and New South Wales (Australia). Several males from a pond near Omsk. Preparations: MGU – female 1529, male 1664. ZIN – female 1530.

Female. Valve with distinct pentagonal-hexagonal reticulation in the ventral and dorsal part (Poggenpol', 1874). Antennules half length of rostrum with a sensory seta laterally. Setae on antennae: 0–0–3/0–1–3. There are 7–9 anal denticles. Distance from natatorial setae to anal denticles slightly longer than that between the first and last anal denticles. Ocellus much smaller than eye and situated halfway between the eye and apex of rostrum. Length to 0.32 mm. In the specimens examined, valves and head shield are distinctly reticulate, and the plate of the labrum has a pointed, produced apex.

Male. Valves strongly reticulate.

Distribution. Europe, Africa, Indo-Malay and Australian regions), in European USSR to Lake Issyk-Kul' and Lake Akzhar (Dzhambul Region) in the east.

1i. **Chydorus sphaericus caelatus** Schoedler, 1862
(Figures 300, 307, 308)

Schoedler, 1862:15, Plate II, Figure 44 (caelatus); 1863:15, Plate II, Figure 44 (caelatus); Brady, 1868:423–424, Figures 3, 4, 5 (var. favosa); Poggenpol', 1874:76, Plate XVI, Figures 31, 32, Plate XVII, Figure 11 (tuberculatus syn.n.); Vereshchagin, 1913a:206 (latus var. coelatus); Frey, 1959:40, Figure 64; 1962a, Figure 64 (var. coelatus).

Material. Several females from the following localities: Cherepovets Reservoir, the Sredne-Vezhinskii pond in the Perm Region, water bodies in Pamir, a small lake on the north coast of Issyk-Kul, Lake Sonkul'. Numerous females from the Frolikh Inlet in Lake Baikal. Numerous males and females from Lake Kadil'noe on the shore of Lake Baikal north of Bol'shie Koty. Preparations: MGU – females 1616, 717, deformed female 1607, male 691. ZIN – female 1617, male 176.

Female. Valves and head shield densely pitted; ventral margin with polygons. Antennules ending at their own length before apex of rostrum. There are 7–8 anal denticles. Distance from natatorial setae to proximal anal denticle twice as long as row of anal denticles. Ocellus almost as large as eye. Length 0.5 mm.

Male. Valve pitted. In the specimens from Lake Kadil'noe (shore of Lake Baikal near Bol'shie Koty), the preanal corner is not protruding and

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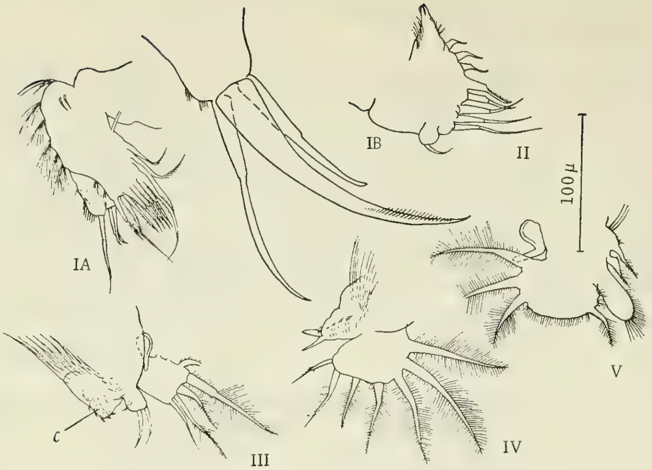

FIGURE 305. Legs of female of Chydorus sphaericus alexandrovi (Lake Diyaty, Vashutkiny lakes, Arkhangel'sk Region, 18 July 1961):

IA – right leg, inner view; IB – outer branch of endite; II, III, IV – left legs, outer view; V – left leg, inner view.

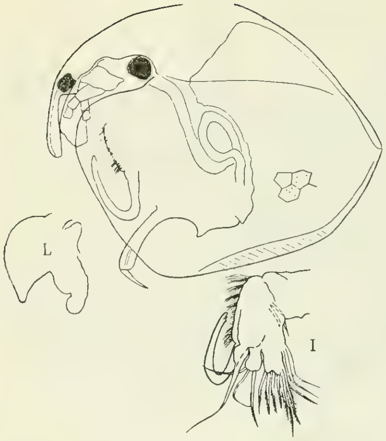

FIGURE 306. Chydorus sphaericus alexandrovi, male, length 0.31 mm (pond near Omsk, 13 September 1964, preparation 1664):

I – left leg I, outer view.

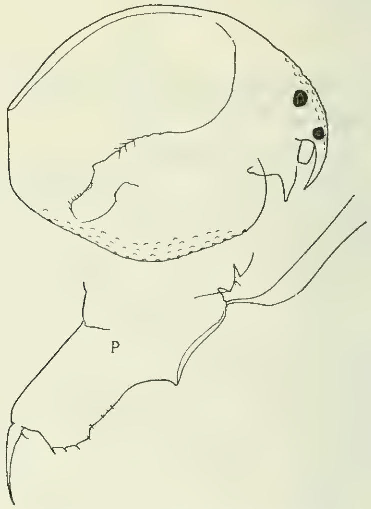

FIGURE 307. Chydorus sphaericus caelatus, female, length 0.42 mm (Cherepovets Reservoir near dam, 8 August 1963, preparation 717):

P – lake southeast of Orenburg, 4 September 1963.

the plate of the labrum has an elongate, pointed apex. Antennules ending less than their own length before apex of rostrum. Length to 0.36 mm.

Distribution. Holarctic Region, European USSR to Lake Baikal.

Also described was Chydorus sphaericus coelatus f. punctatus. – Hellich, 1877:110–111, Figure 66 (punctatus).

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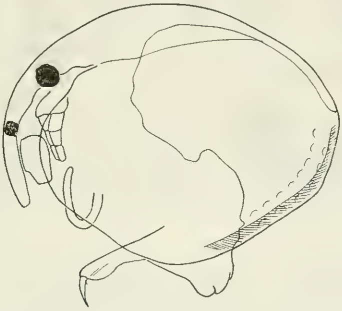

FIGURE 308. Chydorus sphaericus caelatus, male, length 0.36 mm (Lake Kadil'noe, shore of Lake Baikal north of Bol'shie Koty, 21 August 1949, preparation 691)

Female. Valve with pits and polygons, with fine striation and knobs inside the polygons. Postabdomen with 8–9 anal denticles of about equal length. Claw with a basal spine and setae on the concave margin. Ocellus as large as eye, closer to eye than to apex of rostrum.

Male. Rostrum shorter than in female. Antennules with a sensory seta and a long sensory papilla in middle of outer side. Postabdomen narrow. Claw without basal spine or setae.

Distribution. Czechoslovakia, Minnesota (U.S.A.), vicinity of Kiev.

2. Chydorus ovalis Kurz, 1875 (Figures 309–312)

Kurz, 1875:79–80, Plate 3, Figure 11; Hellich, 1877:106, Figures 64, 65 (latus); Lilljeborg, 1900:552–557, Plate LXXVII, Figures 2–17; Herr, 1917:125–126, Figure 37; Bening, 1941:335–337, Figure 40; Šrámek-Hušek et al., 1962:397–399, Figure 150; Herbst, 1962:102–103, Figure 88; Fryer, 1968:354–361, Figures 129, 137.

Material. Two males from Lake Kurul'skoe (basin of the rivers Sysola and Vychegda). Preparations: MGU – male 2056. ZIN – male 1300.

Female. Body with rounded outline. Posteroventral corner rounded, without denticles. Herr (1917) found a specimen with a tubercle on the dorsal side.

Rostrum pointed. Valves with weak reticulation. Antennules with a sensory seta in middle of anterior margin and a sensory papilla in distal part of anterior margin. The other sensory papillae situated on apex of antennule. Antennae with 8 setae. Proximal segment of exopodite and

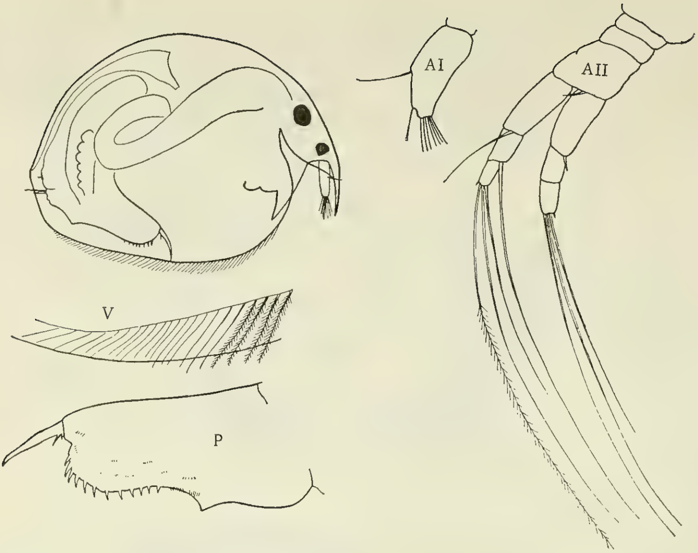

FIGURE 309. Chydorus ovalis, female:

general view – after Kurz, 1875; V – after Stenroos, 1897; P – after Stenroos, 1897; AI, AII – after Lilljeborg, 1900.

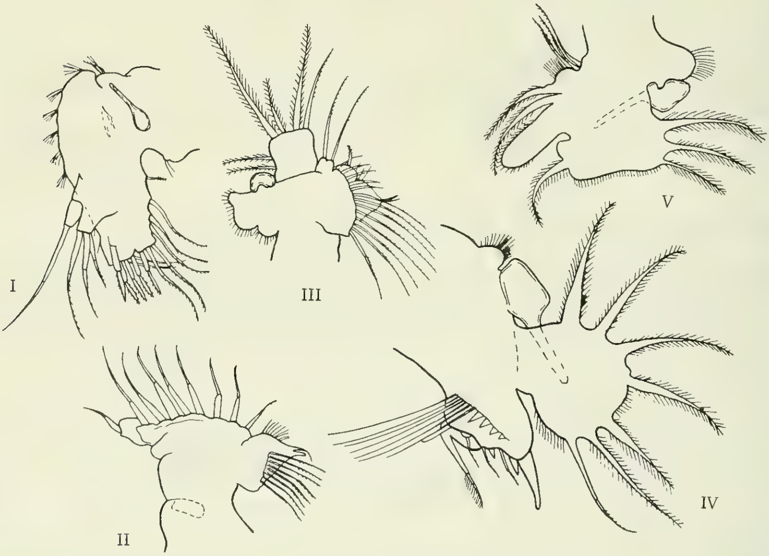

FIGURE 310. Legs of Chydorus ovalis, female (after Lilljeborg, 1900):

I – left leg, outer view; II – left leg, inner view; III, IV, V – right legs, inner view.

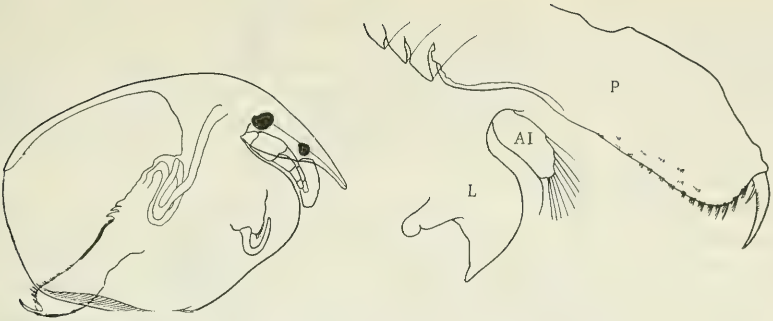

FIGURE 311. Chydorus ovalis, male, length 0.47 mm (Lake Kurul'skoe in the basin of the rivers Sysola and Vychegda, 21 September 1965, preparation 2056): L, AI — after Lilljeborg, 1900.

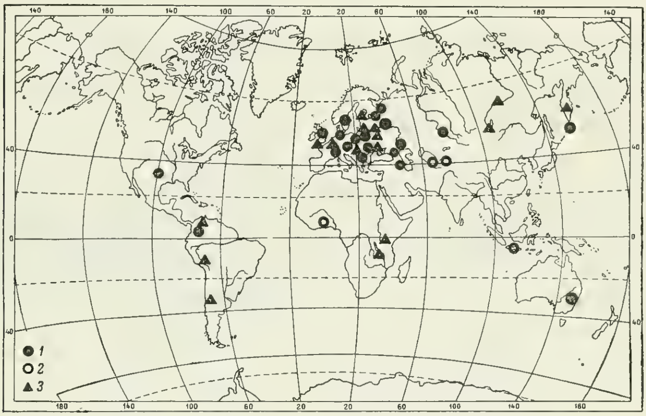

FIGURE 312. Distribution:

1 — Chydorus ovalis; 2 — Ch. herrmanni; 3 — Ch. piger.

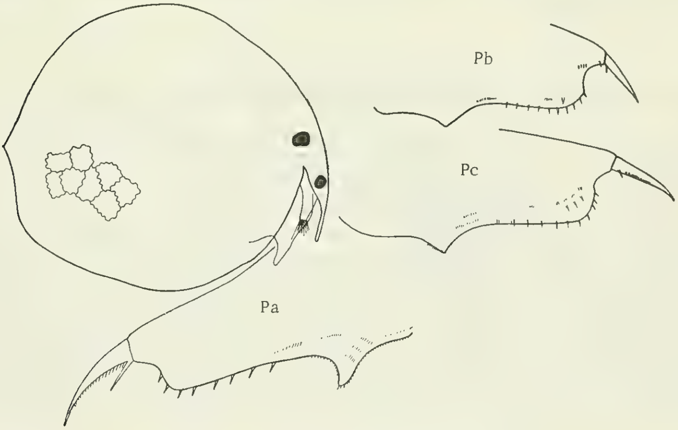

FIGURE 313. Chydorus herrmanni, female, right side:

Pa — after Mukhamediev, 1963a; Pb, Pc — after Brehm, 1933a.

both distal segments with a spine. Plate of labrum with convex ventral margin and pointed posterior process.

Postabdomen short. Preanal corner projecting. Anus wide, with setae on the distal margin. There are 12–15 anal denticles. Ventral margin of postabdomen with 5–6 incisions. Intestine forming loops. Ocellus situated nearer to eye than to apex of rostrum. Legs typical for the genus (Lilljeborg, 1900). Length to 0.65 mm.

Male. Rostrum blunt. Anterior margin of antennules with 2-segmented flegellum and 2 sensory papillae in the distal half with a sensory seta in the proximal half; posterior margin with a sensory seta in the distal part. Preanal corner of postabdomen not projecting. Anus with a group of setae. Dorsal distal margin with two rows of about 15 groups of thin anal denticles. Vasa deferentia opening on ventral side of postabdomen. Length to 0.5 mm.

Distribution. Holarctic Region, a single record from Australia and South America, the European USSR, the Kurile Islands.

3. Chydorus herrmanni Brehm, 1933 (Figures 312–314)

Brehm, 1933a:759–761, Figures 48–53, 1934a:73–74, Figures 25, 26; Mukhamediev, 1963a:80–81, Figure 2 (rylovi syn. n.).

Material. Fourteen females from the southwestern Kyzyl kum; many females from the rivers Susamyr and Karakol in southern Kirghizia.

Female. Maximum height in the middle. Valve with projecting posterodorsal corner; posterior margin less than $^1/_3$ height of body. Valve with reticulation of tetragonal or pentagonal cells with undulate borders. Cell width 10–20μ. Plate of labrum with pointed apex. Postabdomen with projecting preanal corner. Preanal corner with setae. Margin of anus 294 with fine setae, 3–4 groups of 4–6 thin spinules laterally at the preanal corner. There are 8–10 anal denticles. Lateral setae present. Claw with setae on the concave margin. Ocellus almost as large as eye. Length to 0.62 mm.

Male. Claws without basal spine. Postabdomen with dorsal seta on the swollen distal part.

Distribution. Java, the Philippines, West Africa, and Fergana valley and Kyzyl kum (USSR).

4. Chydorus pigroides Lilljeborg, 1900 (Figures 315, 316)

Lilljeborg, 1880, MS (mixtus); 1900:571–573, Plate LXXVIII, Figures 10–14.

Material. According to description.

Female. Valve with undulate lines. Rostrum pointed. Antennules ending far before apex of rostrum. Plate of labrum with pointed apex.

According to Rammner (1940), the antennules have sensory seta in the middle of the anterior margin, all esthetascs situated on apex of antennule. Postanal part of postabdomen narrowing. There are 10–12 anal denticles. Claw with 2 basal spines, proximal spine smaller. Intestine forming loops, with a caecum. Ocellus smaller than eye, situated closer to eye than to apex of rostrum. Length to 0.47 mm.

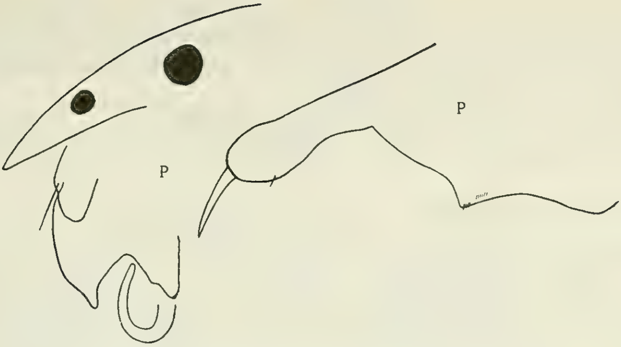

FIGURE 314. Chydorus herrmanni, male (after Brehm, 1933a)

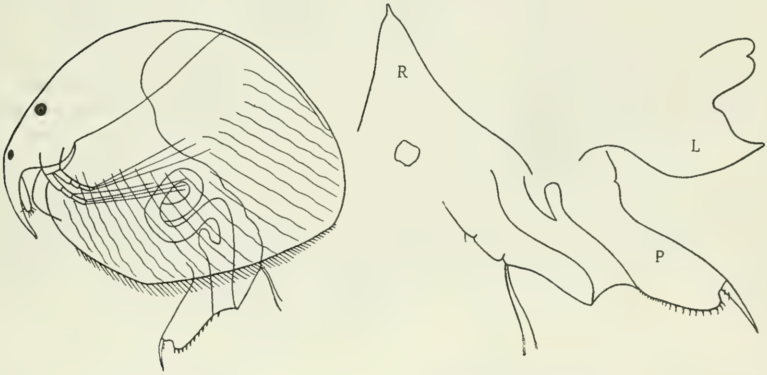

FIGURE 315. Chydorus pigroides, female (after Lilljeborg, 1900)

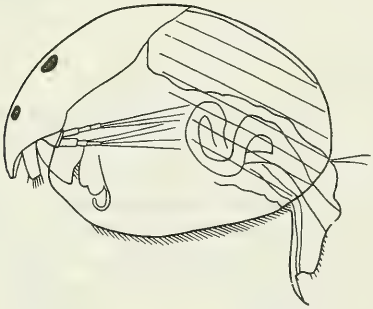

FIGURE 316. Chydorus pigroides, male (after Lilljeborg, 1900)

Male. Rostrum blunt. Antennules reaching apex of rostrum with a sensory seta and a sensory papilla on the anterior margin. Intestine forming loops, with a caecum. Ocellus situated halfway between eye and apex of rostrum. Length to 0.32 mm.

Distribution. Northern and Central Europe.

5. Chydorus piger Sars, 1862

Sars, 1862a:163–164; Fryer, 1968:356–362, Figures 130–135.

Female. Maximum height in middle of body. Posteroventral corner of valves rounded, without denticles. Rostrum blunt, but appearing pointed in lateral view. Head pores typical of the subfamily. Antennules not reaching apex of rostrum, with a sensory seta and 2 sensory papillae laterally. Antennules with 7 sensory papillae at the end. Segments of antennae with rows of spinules. Postabdomen wide, with distinct preanal corner. Margin of anus slightly concave, with fine hairs. Postabdomen with rounded dorsal distal corner. There are 8–9 anal denticles, continuing proximally into a dense row of setae. Preanal corner slightly projecting. Postabdomen with lateral setae. Claws with 2 basal spines, proximal spine small, without hairs on the inner margin. Ocellus slightly nearer to eye than to apex of rostrum. Specimens 0.47 mm long were described as Ch. piger grandis Rammner, 1940 (Ch. thienemanni grandis).

Male. Valve with lines. Rostrum rounded. Antennules not reaching apex of rostrum; anterior margin with 2 sensory setae, the larger seta articulated. Plate of labrum with pointed apex. Postabdomen tapering distally. Claws with 2 basal spines, the proximal spine smaller than the distal one. Vas deferens opening dorsally at base of claws. Length to 0.35 mm.

Key to Subspecies of Ch. piger

1 (2). Valves with undulate lines, without rows of tubercles . . . . 5a. **Ch. piger piger** Sars, 1862.
2 (1). Valves with curved rows of tubercles . . . . 5b. **Ch. piger nodulosa** Lilljeborg, 1900.

5a. Chydorus piger piger Sars, 1862 (Figures 312, 317–319)

Sars, 1862a:163–164; Brady, 1868:423, Figures 1, 2 (Lynceus barbatus); Stenroos, 1897:64–66, Figures 17–24; Lilljeborg, 1900:567–571, Plate 77, Figures 26–29, Plate 78, Figures 1–9 (piger); Scourfield, 1903:445, Plate 24, Figures 11, 12 (barbatus); Stingelin, 1906:323–324, Plate 13, Figures 13, 14, 15 (barbatus); Thiébaud, 1908:87, Plate 2, Figures 1–8 (piger); Gurney, 1915:29, Plate 2, Figures 3–4; Delachaux, 1917:89, Figures 19, 20; Brehm, 1935a:155, Figure 9; Meuche, 1937b:13–16, Figures 1–7 (thienemanni); Geldern, 1939:187–190, Figures 1–3 (Pigroides); Harding, 1955:350, Figures 93, 94; Frey, 1959:40, Figures 61, 62; 1962a, Figures 61, 62; Šrámek-Hušek et al., 1962:390–392, Figure 147 (piger); 348–350, 414, Figures 129, B–G (Paralona thienemanni), 390–392, Figure 147; Herbst, 1962:102, Figure 87 (piger), 103, Figure 89 (thienemanni).

Material. Several tens of females from Lake Baikal. Several males from the same locality. Preparations: MGU – female 2122, male 2094, juvenile male 2133. ZIN – female 2125, male 2095, juvenile male 2096.

295)

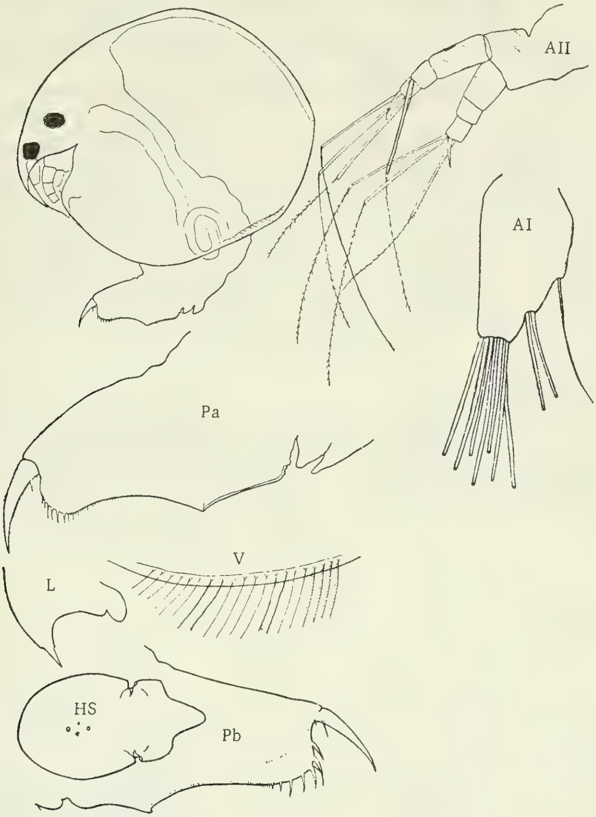

FIGURE 317. Chydorus piger piger, female, length 0.37 mm (Baikal, near the rivers Utulik and Murina, 27 August 1964, preparation 2122):

Pa – postabdomen; L – after Lilljeborg, 1900; HS – after Frey, 1962a; V, Pb, Ai, AII – after Stenroos, 1897.

Female. According to Stenroos (1897), middle of valve with pattern of polygons which pass posteriorly into undulate lines. In specimens from Lake Baikal, the valve is indistinctly reticulate. Ocellus almost as large as eye (not smaller). Length at most 0.46 mm.

295 Male. Antennules not reaching apex of rostrum. Postabdomen tapering distally.

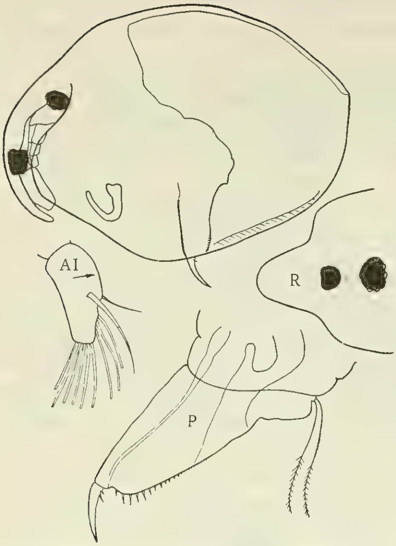

FIGURE 318. Chydorus piger piger, male, length 0.25 mm (Baikal area, near the rivers Utulik and Murina, 28 July 1964, preparation 2094):

AI, R P — after Lilljeborg, 1900.

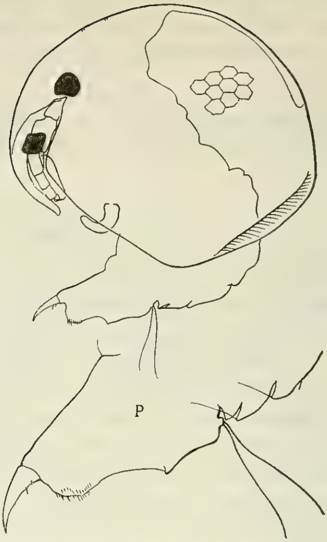

FIGURE 319. Chydorus piger piger, juvenile male, length 0.26 mm (Baikal area, near the rivers Utulik and Murina, 28 July 1964

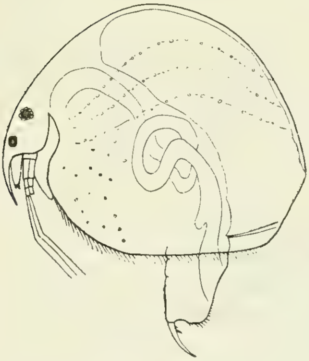

FIGURE 320. Chydorus piger nodulosa, female (after Lilljeborg, 1900)

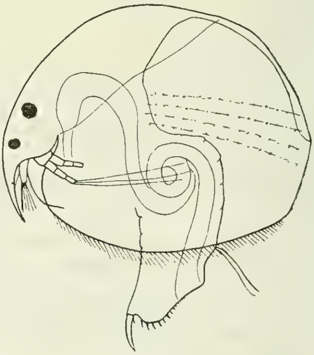

FIGURE 321. Chydorus piger nodulosa tenuissime, female (after Lilljeborg, 1900)

Juvenile male. Postabdomen resembling that of female, but with less developed anal denticles. Claw with 2 basal spines. Leg I with a little developed hook.

Distribution. Holarctic and Ethiopian regions, northwest USSR, Lena River, Kamchatka, Lake Baikal.

5b. **Chydorus piger nodulosa** Lilljeborg, 1900 (Figure 320)

Lilljeborg, 1900, Plate LXXVIII, Figure 3 (var. nodulosa).

Female. Valve with curved rows of tubercles. Length 0.44 mm.

Distribution. Sweden.

Lilljeborg distinguishes two varieties of this subspecies.

Chydorus piger nodulosa perspicue Lilljeborg, 1900, Plate LXXVIII, Figure 5 (var. perspicue nodulosa). Valves of female with curved rows of dense, distinct tubercles. Posterodorsal corner rounded, indistinct. Length 0.3 mm.

Chydorus piger nodulosa tenuissime (Figure 321) Lilljeborg, 1900, Plate LXXVIII, Figure 4 (var. tenuissime nodulosa). Valve of female with curved rows of very small tubercles. Length 0.36 mm.

297 6. **Chydorus nitidulus** (Sars, 1901) comb. n. (Figure 322)

Sars, 1901:64–65, Plate X, Figures 7, 7a (Alonella nitidula was placed in the genus Chydorus because Sars found a row of setae on the inner side of the ventral margin of the valve).

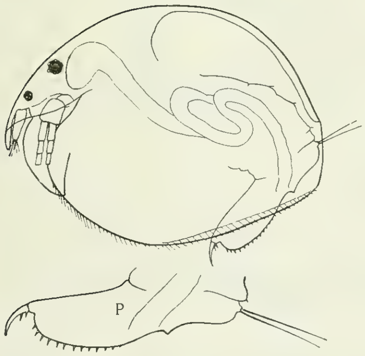

FIGURE 322. Chydorus nitidulus, female (after Sars, 1901)

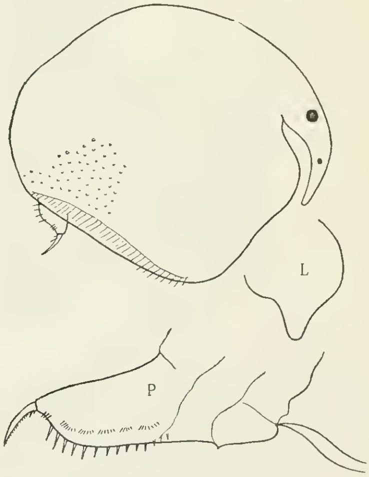

FIGURE 323. Chydorus ventricosus, female (after Daday, 1898)

Material. According to description.

Female. Height of body slightly more than length. Posterior margin truncate, $\frac{1}{4}$ maximum height. Dorsal margin convex, curved, steeply sloping posterior to the posterodorsal corner. Ventral margin convex, maximum convexity in the middle. Valves without sculpture. Posteroventral corner
298 of valve with one denticle. Antennules ending a short distance before apex of rostrum. Preanal corner distinct. About 12 anal denticles. Lateral setae absent. Claws with 2 basal spines. Ocellus smaller than eye. Length 0.34 mm.

Male. Unknown.

Distribution. Lake Itatiba (near São Paulo), New Zealand.

7. **Chydorus ventricosus** Daday, 1898 (Figures 323, 324)

Daday, 1898:28–29, Figure 10; 1910b:121, Plate 6, Figures 1–4 (Daday, 1905 uses the name Chydorus ventricosus in the text (p. 156–157), but at the end of the text he proposes the name Ch. v. var. dentifer, and in the legend to the plate (p. 367) he names it Ch. dentifer n. sp. The illustration (Plate X, Figures 1, 2) correspond to Ch. dentifer (see below)).

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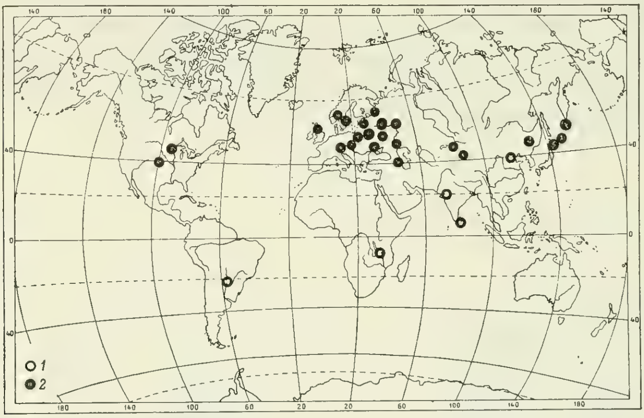

FIGURE 324. Distribution:

1 – Chydorus ventricosus; 2 – Ch. gibbus.

Material. According to description.

Female. Posteroventral corner of valve rounded, without spine. Ventral margin of valve with a convexity in the middle. Valves with indistinct pattern of polygons and dots.

Rostrum pointed, curved. Antennules half length of rostrum. Plate of rostrum curved anteriorly, slightly pointed ventrally. Intestine forming a double loop. Postabdomen with 4–5 lateral curved groups of setae. Twelve anal denticles. Claws with 2 basal spines and with setae on the concave margin. Three spinules between base of the claws and the beginning of the row of anal spinules. Delachaux (1917) illustrates the postabdomen with a row of 8 anal spinules continuing into 3 groups of setae, and with a group of setae on the preanal corner. Ocellus about half size of eye. Length to 1 mm.

Male. Unknown.

Distribution. East China, India, Ceylon, Africa, South America.

8. **Chydorus gibbus** Sars, 1891 (Figures 324–327)

Sars, 1891:50; Birge, 1893:308–309, Plate XIII, Figure 6 (rugulosus); Stenroos, 1897:66–67, Figures 25–29 (rugulosus); Forbes, 1890:712 (rugulosus); Lilljeborg, 1900:573–578, Plate LXXVIII, Figures 15–25; Šrámek-Hušek et al., 1962:388–390, Figure 146; Herbst, 1962:102, Figure 86; Chiang Sieh-chih, 1964:86.

Material. Numerous females from the Volga reservoirs of Ivan'kovo, Uglich, and Rybinsk. One female from Lake Muolan-Yarvi in the Karelian Isthmus. Numerous males from the Rybinsk Reservoir. Preparations: MGU – female 162, male 2001, juvenile male 1969. ZIN – female 53902 (935), male 53903 (1987), juvenile male 53904 (1137). Ph – female 936, male 1999.

(299)

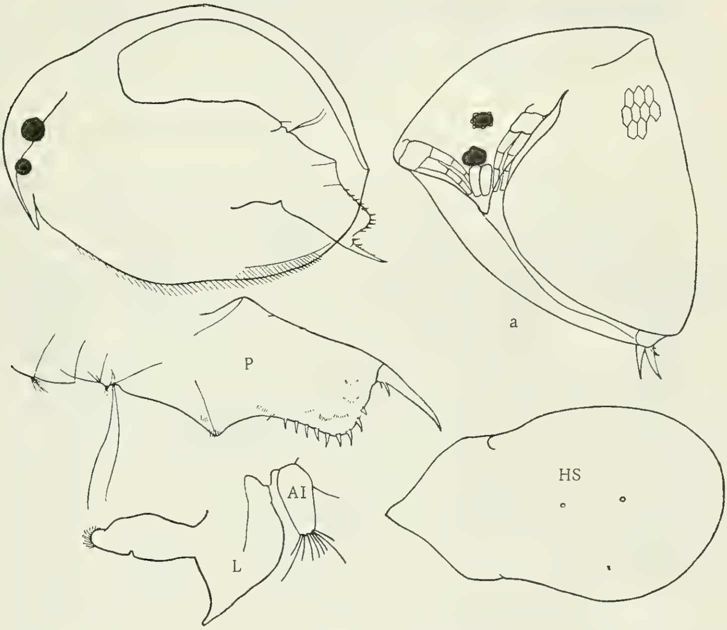

FIGURE 325. Chydorus gibbus, female, length 0.53 mm:

a – anteroventral view; HS – Ivan'kovo Reservoir, 22 July 1962.

(300)

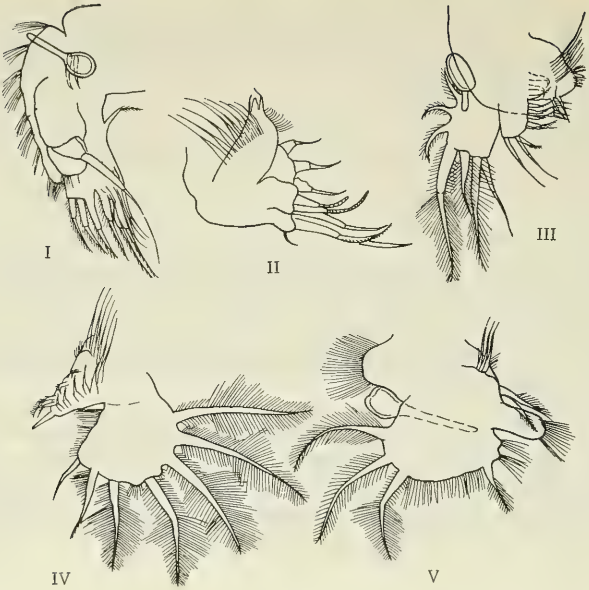

FIGURE 326. Legs of female of Chydorus gibbus, left side (Uglich Reservoir, 23 July 1962):

I, II, IV — outer view; III, V — inner view.

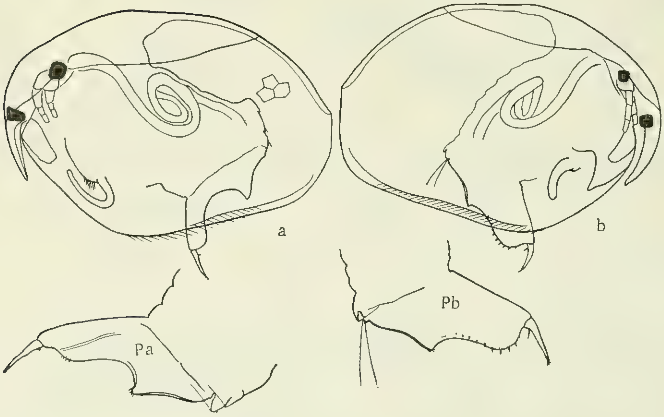

FIGURE 327. Chydorus gibbus:

a — adult male, length 0.39 mm (Rybinsk Reservoir, Borok, 30 September 1965, preparation 2001): Pa — postabdomen; b — juvenile male, length 0.39 mm (Rybinsk Reservoir, Borok, 30 September 1965, preparation 1969); Pb — postabdomen.

Female. Valves with humped dorsal margin. Body triangular in anterior view. Reticulation of valve with hexagonal cells. Rostrum pointed. Head shield with rounded posterior margin. Head pores typical for the subfamily. Antennules with a sensory seta in middle of anterior margin. Antennae with 7 setae. Plate of labrum with convex anterior margin and pointed posterior end.

Postabdomen short. Natatorial setae feathered distally. Preanal corner projecting, pubescent. Distal dorsal margin with 2 rows of 8–10 anal denticles. Claws with setae on the concave margin. Ocellus nearer to eye than to apex of rostrum. Legs typical for the genus. Outer branch of endite of leg I with 2 long setae and a shorter hook-shaped seta. Length, according to specimens from the Rybinsk Reservoir (23 June 1960) 0.34 (1st stage) to 0.56 mm.

Male. Ventral margin of valve with a convexity in the middle. Antennules almost reaching apex of rostrum. Middle of anterior margin of antennule with a 2-segmented flagellum and a sensory seta; a sensory papilla distal to them. Postabdomen with broad base and narrowing distal part. Preanal corner projecting, pubescent. Anal denticles present. Claws with a basal spine and with a row of setae on the concave margin. Ocellus as large as eye or slightly larger. Vas deferens opening at base of claws. Length to 0.45 mm.

Juvenile male. Postabdomen resembling that of the female. Length 0.39 mm.

Distribution. Holarctic, European USSR, Kurile Islands.

Biology. Inhabits the bare littoral.

9. **Chydorus barroisi** (Richard, 1894)

Female. Maximum height in middle of body. Dorsal and ventral margin similarly convex. Valve with straight posterior margin. Posteroventral corner of valve with a denticle, sometimes with an additional smaller denticle before it, or without denticles. Both valves of some specimens
299 have a denticle of varying size at the posteroventral corner; in other specimens this denticle is absent on one or both valves.

According to our data and other data, the presence or absence of teeth on the posteroventral corner of the valve is not a difference from Ch. hybridus and Ch. poppei. Antennules short, conical, not reaching apex of rostrum. Esthetascs almost reaching apex of rostrum. Plate of labrum with produced apex and denticulate anterior margin with 3–5 denticles. Setae on antennae: 0–0–3/0–1–3; distal segments of antenna not reaching apex of rostrum. Claws with setae on the concave margin and with 2 basal spines. Margin of anus with setae. Preanal corner projecting. Lateral setae sometimes present. About 9 anal denticles. Distal part of anus with 2–4 long denticles on one side.

In the description and drawing of Richard (1894a), all 8–9 anal denticles are long and of almost equal length (p. 377 and Figure 12 of Richard). The claws of the postabdomen are stated to have 2 basal spines, the proximal spine very small (p. 377); however, this is not shown in Figure 12.

Outer branch of endite of leg I with 2 long setae and one hook-shaped seta which is about half as long as the other two. Intestine forming loops. Ocellus smaller than eye and situated halfway between the eye and apex of rostrum. Legs typical for the genus. Length to 0.4 mm.

Male. Outline of body oval (Figure 332). Maximum height slightly before the middle. Dorsal and ventral margin strongly and similarly convex. Posterior margin slightly convex, about $^1/_3$ maximum height of body. Posterodorsal corner rounded. Posteroventral corner with a small denticle behind the row of setae. Head shield passing smoothly into dorsal margin of valves. Dorsal side without keel. Ventral margin of valve with a row of setae in the posterior half situated on the inner side. Rostrum directed ventrally. Antennules reaching middle of rostrum. Antennae longer than antennules, not reaching apex of rostrum. Labrum with plate-
301 shaped process directed ventrally. Anterior margin of process with several denticles, marginal denticles forming steps.

Postabdomen short. Preanal corner indistinct. Postanal margin with several denticles; distal part of anus with 3 very long denticles on each side. Claws with one basal spine. Intestine forming loops. Ocellus smaller than eye, situated in middle between eye and apex of rostrum. Vas deferens opening on ventral side of postabdomen near base of claws; postabdomen with stepped margin at the opening. Leg I with a hook; endite with a group of setae opposite the hook. Length to 0.3 mm.

Key to Subspecies of Ch. barroisi according to Females

1 (2). Anterior part of valves with lines parallel to anterior margin . . . . 9a. **Ch. barroisi barroisi** (Richard, 1894).
2 (1). Anterior part of valves without lines . . . . 9b. **Ch. barroisi laevis** Sars, 1904.

9a. Chydorus barroisi barroisi (Richard, 1894)
(Figures 328–333)

Richard, 1894a:375–377, Figures 9–12 (Pleuroxus barroisi); Sars, 1895:25–28, Plate 4, Figures 9–13 (barroisi); 1901:67, Plate X, Figures 1, 1a, 1b; 1916:339–340, Plate XL, Figures 6, 6a, 6b; Vereshchagin, 1916:19–21, Figures 14–18 (barroisi); Delachaux, 1917:89, Figures 17, 18; Shikleev, 1930b:344–346, Figures 14–18 (Alonella); Bergamin, 1939, Plate 1, Figure 6; 90–91, Figure 12 (tridentatus). (Chydorus tridentatus Bergamin, 1931 – reference to the apparently unpublished dissertation of Bergamin, F., 1931, Estudio systematico des Cladocera des aguas do municipio de S. Paulo. Thèse inaugural), 91, Figure 13; Bening, 1941:337–339, Figure 141; Rey and Saint-Jean, 1968:113, Figure 29 (barroisi); Smirnov, 1969b, Figure 3b (barroisi).

Material. Several tens of females from ponds in the Kalgan-Chirchik fish farm, from Prospect Reservoir (Sydney, New South Wales, Australia), from the Gayndah pond (Queensland, Australia), from the Atkinson Lagoon (Queensland). Preparations: MGU – female 1344, 1766, 1447, male 1261. ZIN – female 53899 (1343), male 53900 (156).

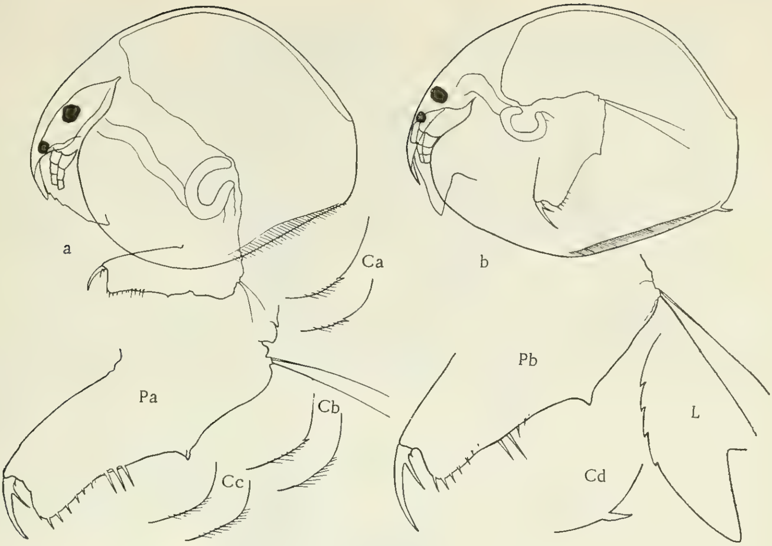

FIGURE 328. Chydorus barroisi, female:

a — left side, length 0.3 mm (Prospect Reservoir, Sydney, Australia, 1963. 5.2, preparation 1344); Ca — posteroventral corners of valves, preparation 1344; Cb — posteroventral corner of valves, preparation 1343; Cc — posteroventral corner of valves, preparation 1447; Pa — preparation 1344; b — female without denticles on visible part of plate of labrum, length 0.26 mm, preparation 1758; Pb — postabdomen; L — labrum of another specimen, preparation 1766; Cd — posteroventral corner of left valve, preparation 1766 (pond at Gayndah, Queensland, Australia, 29 October 1964).

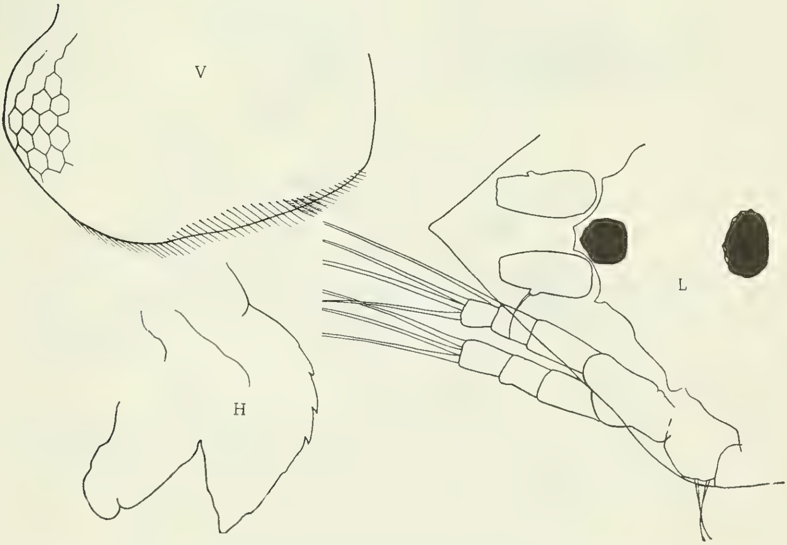

FIGURE 329. Chydorus barroisi, female (Prospect Reservoir, Sydney, New South Wales, Australia, 2 May 1963).

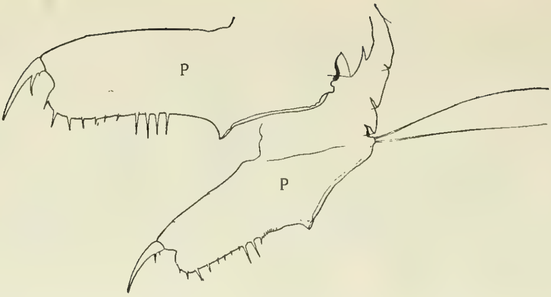

FIGURE 330. Chydorus barroisi, female. Variation of postabdomen (Prospect Reservoir, Sydney, Australia, 2 May 1963).

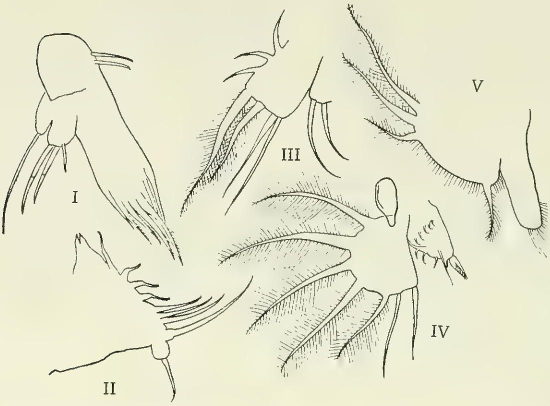

FIGURE 331. Chydorus barroisi, female, legs:

1 – left leg, posterior view; II – left leg, outer view;
III – left leg, inner view; IV, V – right legs.

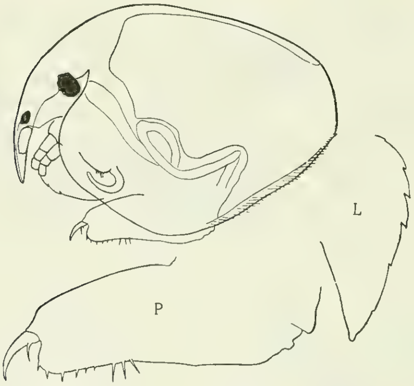

FIGURE 332. Chydorus barroisi, male, length 0.23 mm (preparation 1261):

L – preparation 156; P – preparation 1261.

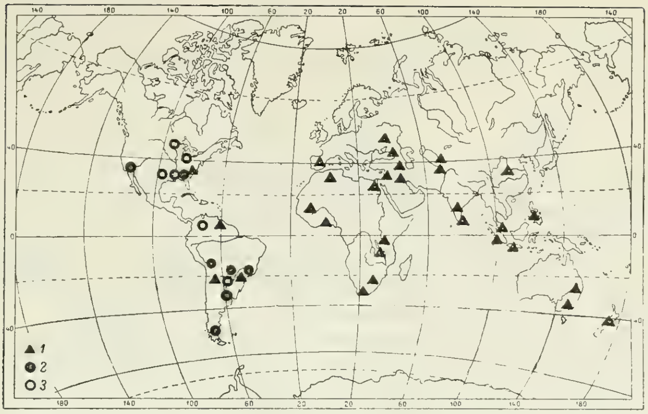

FIGURE 333. Distribution of species of Chydorus with denticulate anterior margin of labrum:

1 – Ch. barroisi; 2 – Ch. poppei; 3 – Ch. hybridus.

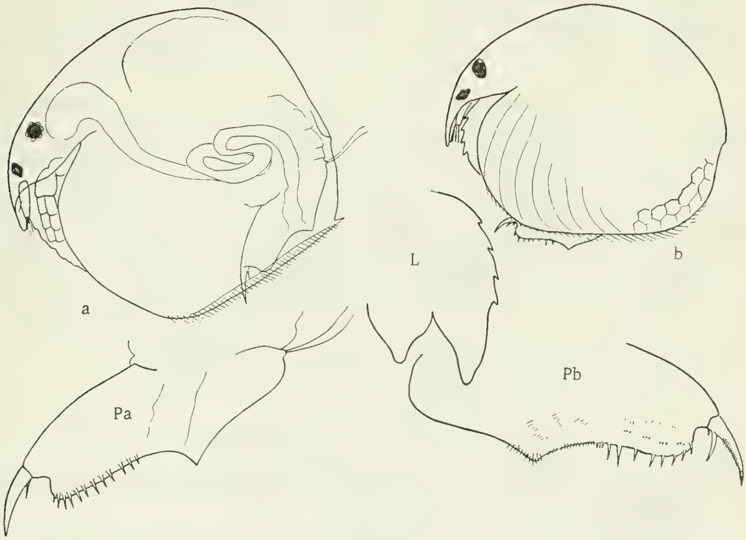

FIGURE 334. a – Chydorus barroisi laevis, female (after Sars, 1904b): b – Ch. phintonicus (after Margaritora, 1969).

Female. Valve with pattern of polygons and lines, parallel to anterior margin in anterior part of valve.

Distribution. Between 50°N and S, Caucasus, upper reaches of the Don, Central Asia.

9b. **Chydorus barroisi laevis** Sars, 1904 (Figure 334)

Sars, 1904b:636, Figures 9, 9a (var. laevis).

Female. Valve without lines (absent also in anterior part). Posterodorsal corner of valve little differentiated. Ventral margin of valve strongly convex in the middle. Posteroventral corner with a denticle. Plate of labrum with serrated anterior margin. Preanal corner distinct. About 12 anal denticles. Claws with a basal spine. Ocellus smaller than eye, slightly nearer to eye than to apex of rostrum. Length 0.28 mm.

Distribution. New Zealand.

10. **Chydorus phintonicus** Margaritora 1969 (Figure 334)

Margaritora 1969:173–180, Figures 1–4; 1970:19.

Material. According to description.

Female. Posteroventral corner of valves without denticles. Ventral margin of valves with feathered setae, slightly concave in the middle. Valve with pattern of polygons, with 8 lines parallel to anterior margin of valve anteriorly. Rostrum pointed. Antennules ending far before apex of rostrum; esthetascs reaching apex of rostrum. Plate of labrum with 4 denticles.

Postabdomen with 7–9 anal denticles and 1–4 small anal denticles proximal to them. The penultimate of the large anal denticles slightly longer than the others. Four groups of 3–4 teeth and setae laterally. Preanal corner projecting with setae. Anal margin with setae. Claws with setae on the concave margin and with 2 basal spines, proximal spine smaller. Ocellus smaller than eye, situated nearer to eye than to apex of rostrum. Ephippium with pattern of polygons. Length to 0.36 mm.

Male. The author found only a single male but gives only its length – 0.27 mm.

Distribution. Caprera Island, West Italy; Sardinia.

306 11. **Chydorus poppei** Richard, 1897 (Figures 333, 335)

Richard, 1897b:296, Figures 44, 45; Sars, 1901:68–69, Plate XI, Figures 2, 2a–2c; Harding, 1955:351, Figure 99.

Material. According to description.

Female. Posteroventral corner of valves without denticles. Plate of labrum with indistinct teeth. Postabdomen with very long denticles on margin of anus. Postabdomen with lateral setae in curved groups. Ocellus smaller than eye, situated about in middle between eye and apex of rostrum. Length to 0.32 mm.

(305)

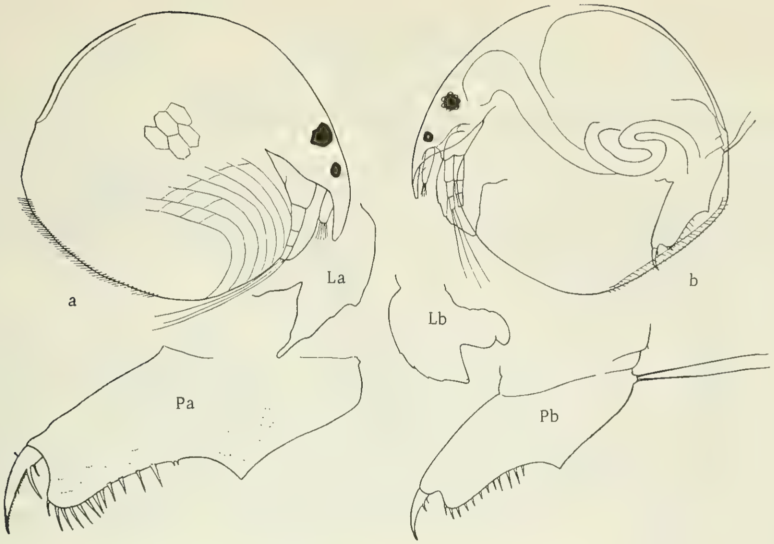

FIGURE 335. Chydorus poppei, female. Variation:

a, Pa — after Richard, 1897; La — Harding, 1955; b, Lb, Pb — after Sars, 1901.

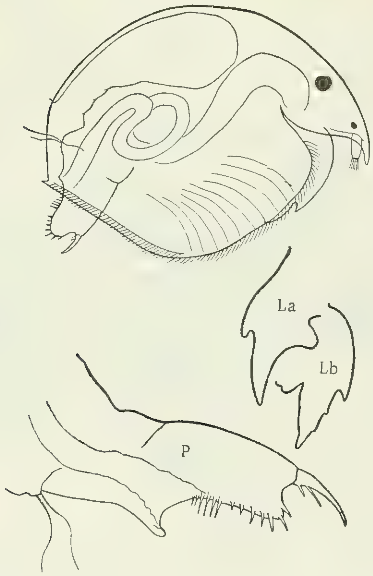

FIGURE 336. Chydorus hybridus, female, right side:

La, P — after Daday, 1905; Lb — after Delachaux, 1919.

Male. Unknown.

Distribution. North and South America.

12. Chydorus hybridus Daday, 1905 (Figures 333, 336)

Vavra, 1900:24–25, Figure 7 (Poppei); Daday, 1905:158–159, Plate X, Figures 5, 6, 7; Delachaux, 1919:32–33, Plate III, Figures 7, 8 (poppei); Shikleev, 1930b:345, Figure 14 (Alonella barroisi); Brehm, 1933a: 757–758, Figure 45 (barroisi); Birabén, 1939:668–669, Figures 22, 23, 24 (poppei); Bergamin, 1940:98, Figure 15 (poppei).

Material. According to description.

Female. Posterior margin of valves almost straight, to $^1/_3$ maximum height. Valves with lines and finely granulate. Posteroventral corner of valve with a denticle. According to Delachaux (1010), the denticle may be absent. Plate of labrum with a single denticle with a pointed process. Antennules spindle-shaped, almost reaching apex of rostrum. Postabdomen abruptly narrowing behind preanal corner. Anal denticles 6–7. Distal margin of anus with 4–5 long and 2–3 shorter setae. Preanal corner pointed, projecting. Claws with 2 basal spinules, proximal spinule smaller.

Male. Unknown.

Distribution. North and South America.

13. Chydorus eurynotus Sars, 1901

Female. Posteroventral corner of valve rounded, without denticles. Valve with a honeycomb, pattern, cells with sinuate margin. Rostrum pointed. Head shield with rounded posterior margin. Head pores typical for the subfamily. Antennules not reaching apex of rostrum. Setae on antennae: 0–0–3/0–1–3. Distal segments of antenna not reaching apex of antennules. Plate of labrum broadly rounded, slightly depressed anteroventrally.

Postabdomen with projecting preanal corner. Row of anal denticles (about 12) passing into a row of setae. Lateral setae present. Claws with 2 basal denticles. Intestine forming loops. Legs typical for the genus. Outer branch of endite of leg III with 3 setae of about equal length; 2 of the setae thin, the third thick, hook-shaped. Length to 0.47 mm.

Male. Posteroventral corner of valves rounded, without denticles. Antennules and antennae not reaching apex of rostrum. Plate of labrum rounded, with blunt apex. Postabdomen widened distally, with obliquely truncate apex. Several anal spinules present. Claws with a single basal denticle. Preanal corner not projecting. Length 0.32 mm.

Key to Subspecies of Ch. eurynotus

1 (6). Valve reticulate or pitted. Plate of labrum without papilliform apical process.

2 (3). Valve slightly reticulate; pits absent. . . . . 13a. Ch. eurynotus eurynotus Sars, 1901.

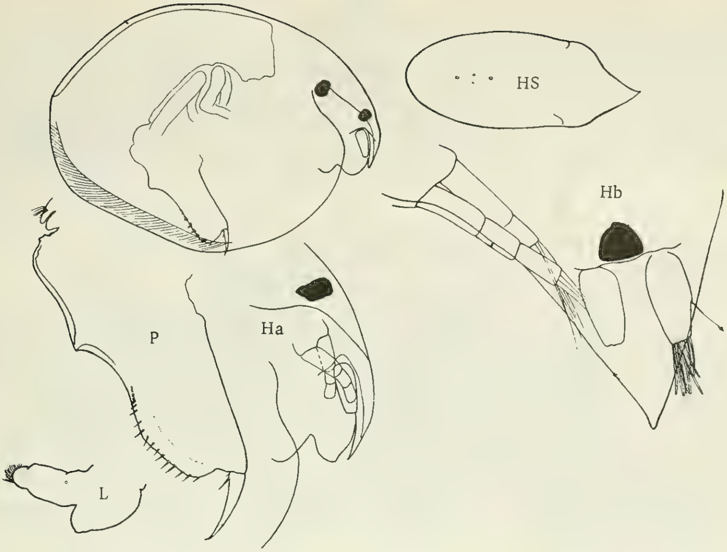

FIGURE 337. Chydorus eurynotus eurynotus, female, length 0.30 mm (University Pond, Brisbane, Queensland, Australia, 20 February 1964, preparation 1578). Ha — head of another specimen, preparation 1579; P — upper Nile; L — Charleville, Queensland, Australia, 2 September 1961; HS — University Pond, Brisbane, Queensland, Australia; Hb — Charleville, Queensland, Australia, 2 September 1961.

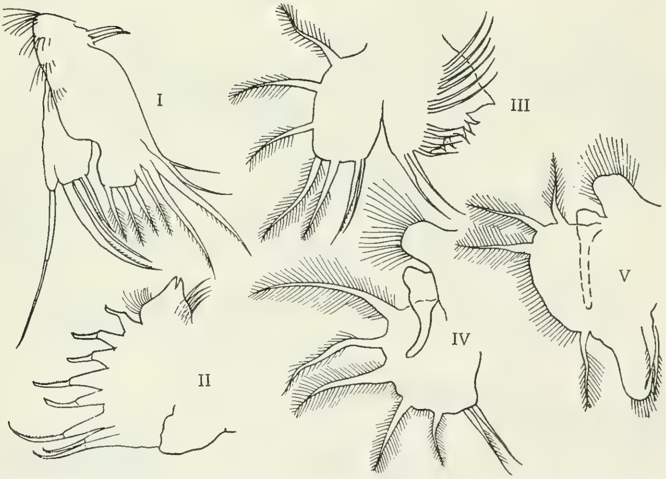

FIGURE 338. Legs of female of Chydorus eurynotus eurynotus (upper Nile):

I — right leg, anterolateral; II — right leg, lateral; III, V — left leg, inner view; IV — right leg, inner view.

3 (2). Valve strongly reticulate or pitted.
4 (5). Valve strongly reticulate . . . . 13b. **Ch. eurynotus reticulatus** Daday, 1898, comb. n.
5 (4). Valve pitted . . . . 13c. **Ch. eurynotus caelatus** N. N. Smirnov, ssp. n.
6 (1). Valve without pattern or pits; plate of labrum with a papilliform apical process . . . 13d. **Ch. eurynotus brehmi** Biswas, 1966, comb. n.

13a. **Chydorus eurynotus eurynotus** Sars, 1901
(Figures 337–340)

Sars, 1901:70, Plate 11, Figures 3, 3a–c (eurynotus); Daday, 1905:157–158, Plate X, Figures 3, 4 (flavescens, synonymized by Frey, 1960); Gurney, 1927:76–77, Figure 11 (denticulatus); Bergamin, 1939: Plate 1, Figures 5, 91–92, Figure 14; 1940:98–99, Figure 16 (nomeralis – reference to the apparently unpublished dissertation of Bergamin F., 1931,
308 Estudio systematico des Cladocera des aguas do municipio de S. Paulo. Thèse inaugural); Gauthier, 1939:183–188, Figure 11 (eurynotus); Harding, 1955:350, Figures 95–98 (eurynotus); 1957b:83–84, Figures 47–49 (eurynotus);

Material. Numerous females from White Nile, from Queensland and New South Wales (Australia). Preparations: MGU – female 1578. ZIN – female 53901 (1579).

Female. Valve slightly reticulate.

Distribution. Ethiopian, Indo-Malay, Australian, and Neotropical regions.

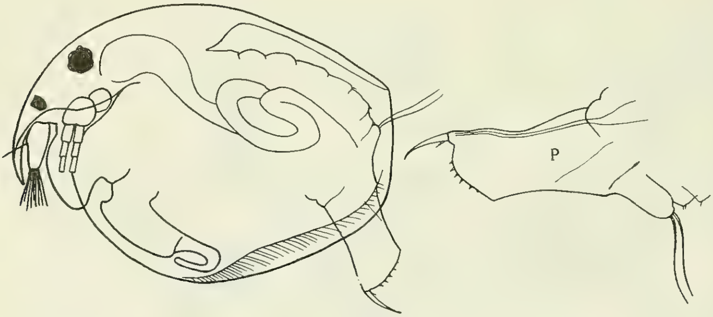

FIGURE 339. Chydorus eurynotus eurynotus, male (after Sars, 1901)

13b. **Chydorus eurynotus reticulatus** Daday, 1898, comb. n. (Figures 340, 341)

Daday, 1898:27–28, Figure 9 (reticulatus); Gauthier, 1939:183–188, Figure 11 (eurynotus).

Female. Posteroventral corner of valve rounded, without denticles. Posterodorsal corner of valve pointed. Valves with pattern of hexagons and dots inside them. Rostrum long, pointed, curved posteriorly. Anterior margin of head with a convexity near the eye. Antennules reaching middle of rostrum. Plate of labrum with differentiated but not produced apex. Postabdomen tapering distally. Anal denticles 8–10. Claws with 2 basal spines and with setules on the concave margin. Ocellus half as large as eye. Length 0.35 mm.

Distribution. Indo-Malayan Region, Lake Chad.

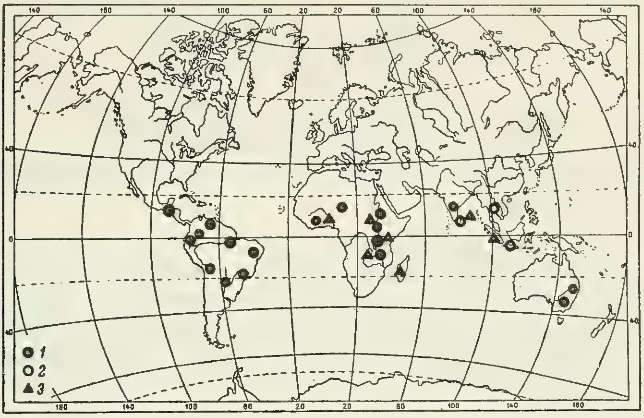

FIGURE 340. Distribution:

1 – Chydorus eurynotus eurynotus; 2 – Ch. eurynotus reticulatus; 3 – Ch. parvus parvus.

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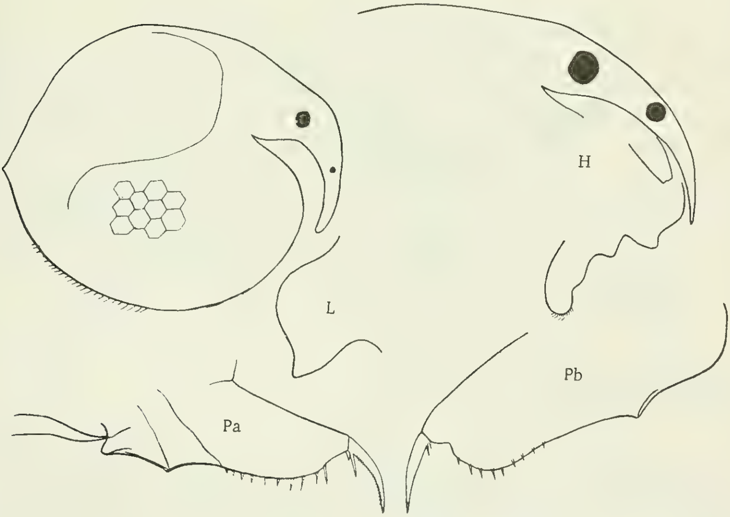

FIGURE 341. Chydorus eurynotus reticulatus, female, right side:

L, Pa – after Daday, 1898; H, Pb – after Brehm, 1933a.

13c. Chydorus eurynotus caelatus N. N. Smirnov, ssp. n. (Figure 342)

Green, 1952:430, Figures 36, 37, 38 (eurynotus).

Material. Several tens of females from a pond near Gayndah, Queensland, Australia. Holotype: MGU – female 1749. Paratype: ZIN – female 53849 (1756).

Female. Valve pitted, especially in the middle. Postabdomen with 5 anal denticles which continue proximally into a row of setae. Length 0.33 mm.

Distribution. Australia, West Africa.

13d. Chydorus eurynotus brehmi Biswas, 1966, comb. n.

Brehm, 1936b:297, Figure 5 (Chydorus n. sp.?); Biswas, 1966:113–114, Figure 1 (brehmi).

Female. Valve without sculpture. Plate of labrum with rounded anterior margin, blunt apically but ending in a papilliform process. Antennules ending far before apex of rostrum. Postabdomen with distinct preanal corner. About 12 anal denticles. Lateral setae in several groups, irregularly distributed on sides of postabdomen. Ocellus about half as large as eye, situated slightly nearer to the eye than to apex of rostrum. Length 0.59 mm.

Distribution. Northwest India.

14. Chydorus kallipigos Brehm, 1934 (Figure 343)

Brehm, 1934a:74–75, Figures 27, 28, 29; Harding, 1955:352, Figures 100–103.

Material. Numerous females from the White Nile.

Female. Posterodorsal corner of valve distinct, posteroventral corner rounded, without spines. Antennules ending far before apex of rostrum. Plate of labrum broadly rounded, without depression in distal part of anterior margin. Postabdomen with strongly projecting preanal corner. About 8 anal denticles. Margin of anus with setae. Claws with setae on concave margin and with 2 basal spines, proximal spine very small. Outer branch of endite with 3 setae of about equal length, 2 setae thin, the other thick, hook-shaped. Length 0.47 mm.

Male. Unknown.

Distribution. Ethiopian Region.

311 15. Chydorus parvus Daday, 1898

Female. Posteroventral corner of valves rounded, without denticles. Anterior margin of valves with tubercles on the inner side. According to Fryer (1957) a specimen may have different numbers of knobs on the right and left valve. Hexagonal reticulation sometimes present on valves.

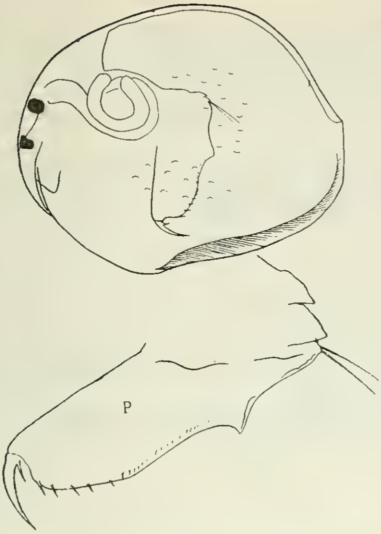

FIGURE 342. *Chydorus eurynotus caelatus*, female, length 0.33 mm (pond near Gayndah, Queensland, Australia, 29 October 1964, preparation 1749).

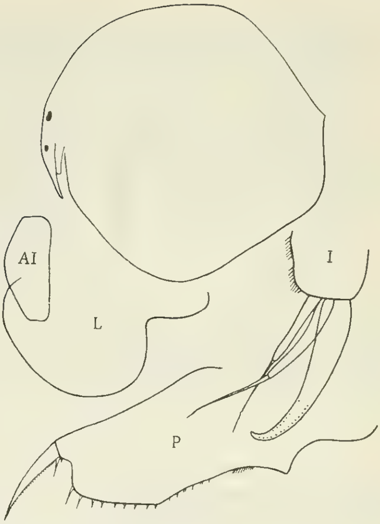

FIGURE 343. *Chydorus kallipigos*, female (after Brehm, 1934a):

I — outer branch of endite of leg I.

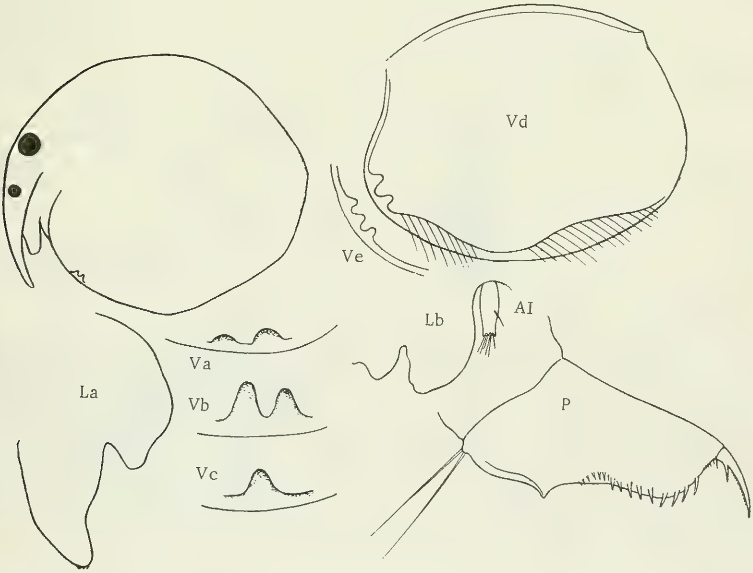

FIGURE 344. *Chydorus parvus parvus*, female, left side:

La, Va, Vb, Vc — after Fryer, 1957; Vd, Ve, AI, Lb, P — after Stingelin, 1905.

Antennules almost reaching apex of rostrum. Plate of rostrum rounded, without pointed apex. Postabdomen with strongly projecting preanal corner. Anal denticles 8–10. According to Jenkin (1934) the postabdomen bears lateral groups of setae. There are setae proximal and distal to the row of anal spinules. Length to 0.38 mm.

Male. Preanal corner of postabdomen not projecting. Six thin, long anal denticles. Claws with 2 basal teeth. Length 0.22 mm.

Biology. Lives in vegetation.

Key to Subspecies of Ch. parvus according to Females

1 (2). Antennules narrow . . . . 15a. **Ch. parvus parvus** Daday, 1898.
2 (1). Antennules broad, ratio of width:length 10:11 . . . . 15b. **Ch. parvus laticornis** Brehm, 1953.

15a. **Chydorus parvus parvus** Daday, 1898
(Figures 340, 344, 345)

Daday, 1898:25–26, Figure 7 (sphaericus var. parvus); Stingelin, 1905:350–361, Plate 13, Figures 35–38 (robustus); Brehm, 1933a:756–757, Figures 42, 43, 44 (robustus); 1953b:341 (robustus).

Material. Several females from the White Nile.

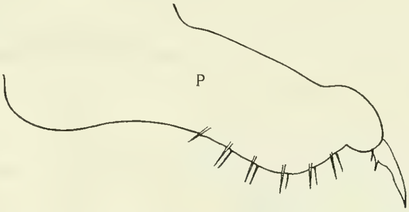

FIGURE 345. Postabdomen of Chydorus parvus parvus, male (after Fryer, 1957)

Female. Posteroventral corner of valve without denticles. Posterodorsal corner rounded, indistinct. Rostrum blunt. Antennules slightly tapering distally, 3 times as long as wide. Antennules ending less than their length from apex of rostrum. Distal segments of antennae not reaching apex of antennules of labrum. Plate broadly rounded, slightly depressed anteroventrally. Ocellus smaller than eye, situated halfway between eye and apex of rostrum.

Distribution. Ethiopian and Indo-Malayan Region.

15b. **Chydorus parvus laticornis** Brehm, 1953

Brehm, 1953c:167–168, Abb. 4 (var. laticornis).

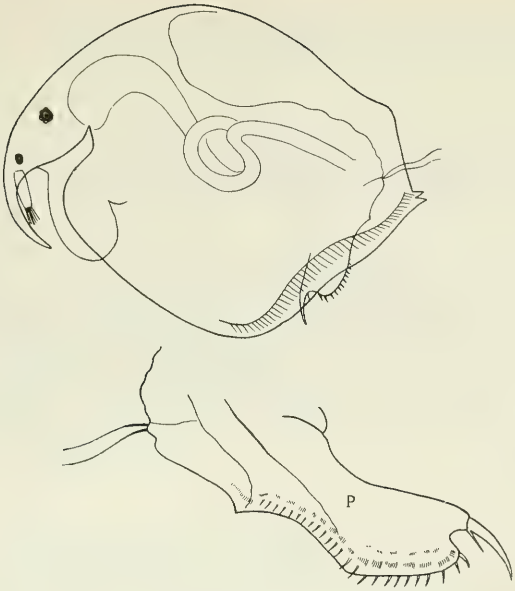

FIGURE 346. Chydorus dentifer, female (after Daday, 1905)

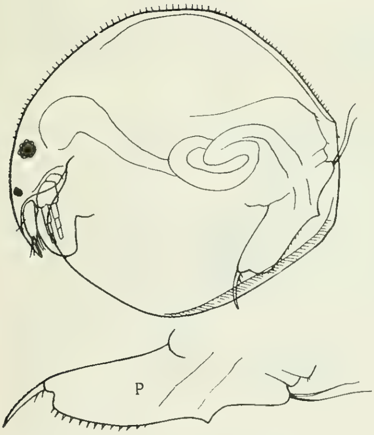

FIGURE 347. Chydorus ciliatus, female (after Sars, 1901)

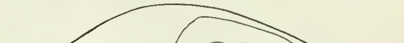

FIGURE 348. Chydorus ciliatus, male (after Sars, 1901)

Ratio of width:length of antennule 10:11 (to base of distal denticles). Distal end of antennules with 6 denticles.

Distribution. Borneo.

16. **Chydorus dentifer** Daday, 1905 (Figure 346)

Daday, 1905:156–157, Plate X, Figures 1, 2 (ventricosus, var. dentifer).

Material. According to description.

Female. Valves with denticles on the posteroventral corner. Rostrum pointed. Antennules ending slightly more than their length before apex of rostrum. Plate of labrum oval. Postabdomen with projecting preanal corner. Margin of anus concave. Anal denticles about 20. Lateral groups of setae present. Claws with a single basal denticle. Intestine forming loop. Ocellus situated nearer to eye than to apex of rostrum.

Male. Unknown.

Distribution. Paraguay.

17. **Chydorus ciliatus** Poggenpol, 1874 (Figures 347–349)

Poggenpol', 1874:76, Plate XVI, Figure 30, Plate XVII, Figures 9, 10; Sars, 1901:71–73, Plate XI, Figures 4, 4a–c (pubescens syn. n.); Bergamin, 1940:99, Figure 17 (pubescens); Rahm, 1956:260–261, Figure 21 (pubescens); Goulden, 1966a:379 (pubescens); 1966b:105, Plate 3, Figure 7 (pubescens).

Material. According to description.

(313)

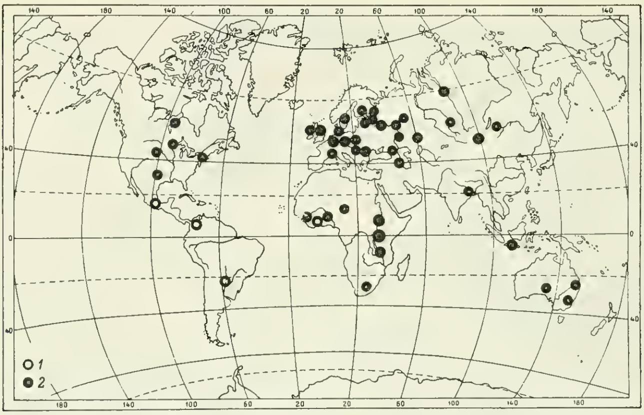

FIGURE 349. Distribution:

1 – Chydorus ciliatus; 2 – Pseudochydorus globosus globosus.

Female. Valves truncate posteriorly. Valves sometimes slightly higher than long. Posteroventral corner of valve rounded, without denticles. Valve reticulate in ventral part. Dorsal surface of valve with numerous 313 hairs. Antennules with a sensory seta on the side. Setae on antennae: 0–0–3/0–0–3. Segments of antenna without spines. Plate of labrum rounded. Distance from natatorial setae to anal denticles slightly less than distance between first and last anal denticle. Claws with 2 basal spines. Ocellus situated in middle between eye and apex of rostrum. Length to 0.35 mm.

Male. Valves with straight posterior margin. Posterodorsal corner of valves distinct. Posteroventral corner broadly rounded, without denticles. Antennules and antennae not reaching apex of rostrum. Plate of labrum rounded. Postabdomen with narrowing distal part. Several anal denticles. Claws with 2 basal denticles. Ocellus situated halfway between eye and apex of rostrum.

Distribution. South America, West Africa. USSR: Moscow (apparently introduced).

18. **Chydorus faviformis** Birge, 1893 (Figure 350)

Birge, 1893:307–308, Plate XIII, Figures 7, 8; Frey, 1959:40, Figure 60; 1962a, Figure 60.

Material. One female from Little Sunapee Lake, New Hampshire, U.S.A. Preparation: MGU – female 2520.

Female. Valves and head shield with deep polygonal cells. Rostrum pointed. Head shield with rounded posterior margin. Head pores typical for the subfamily. Antennules not reaching apex of rostrum. Antennae extending beyond apex of antennules. Postabdomen wide, with rounded apex. Preanal corner projecting. Anal denticles 9–10. Claw with a single basal spine. Length to 0.6 mm.

Male. Unknown.

Distribution. Northeast of the U.S.A.

19. **Chydorus bicornutus** Doolittle, 1909 (Figures 351, 352)

Doolittle, 1909:154–155; 1911:165–169, Plates 17, 18, 19.

Material. One female from Tewkbury Pond, New Hampshire, U.S.A. Preparation: MGU – female 2521.

Female. Valve with pattern of deep polygons, with crests and a lateral horn. Horn as long as width of body. Height of female $^{5}/_{6}$ of length. Ventral margin of valves with feathered setae on the inner side. Rostrum long, pointed. Antennules ending at their length before apex of rostrum. Antennae shorter than antennules, setae: 0–0–3/0–1–3, spines: 0–0–1/0–0–0. One seta on the 3rd segment of the ventral (inner) branch a third as long as the others. Plate of labrum very small. Postabdomen with 12 anal denticles. Lateral setae present. Preanal corner projecting. Anal margin with setae. Claws with setae on the concave margin and with 2 basal spines, distal spine twice as long as the proximal. Ocellus situated nearer to eye than to apex of rostrum. Legs typical for the genus (Figure 352).

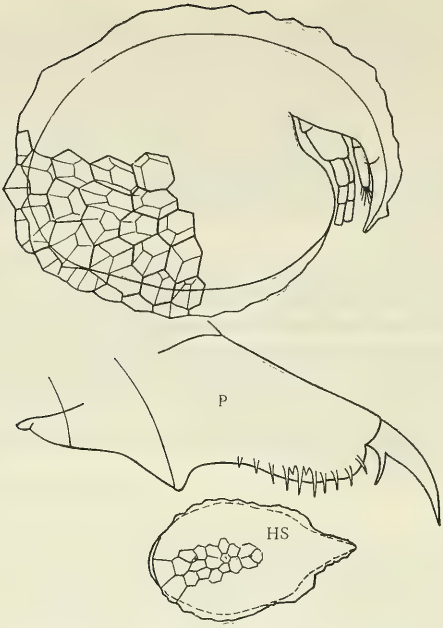

FIGURE 350. Chydorus faviformis, female, right side:

P — after Birge, 1893; HS — after Frey, 1962a.

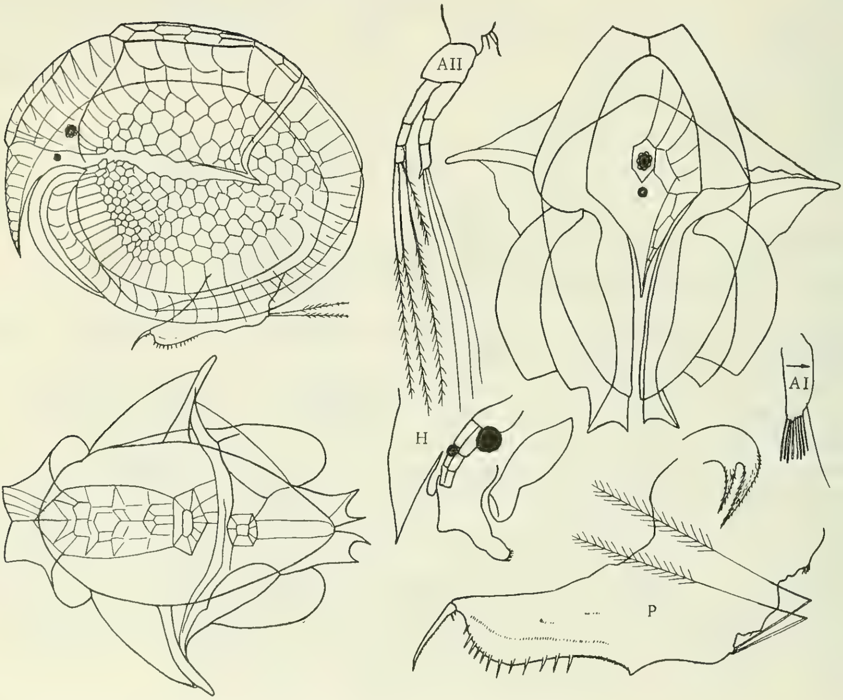

FIGURE 351. Chydorus bicornutus, female (after Doolittle, 1911)

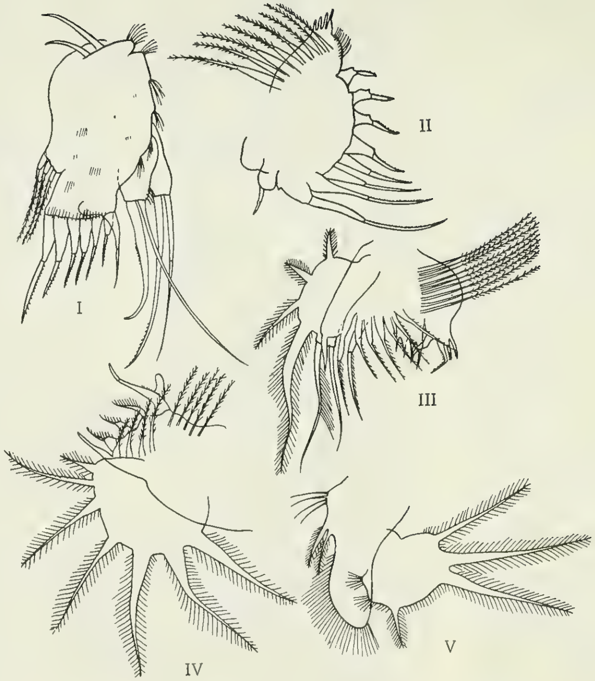

FIGURE 352. Legs I–V of female of Chydorus bicornutus (after Doolittle, 1911)

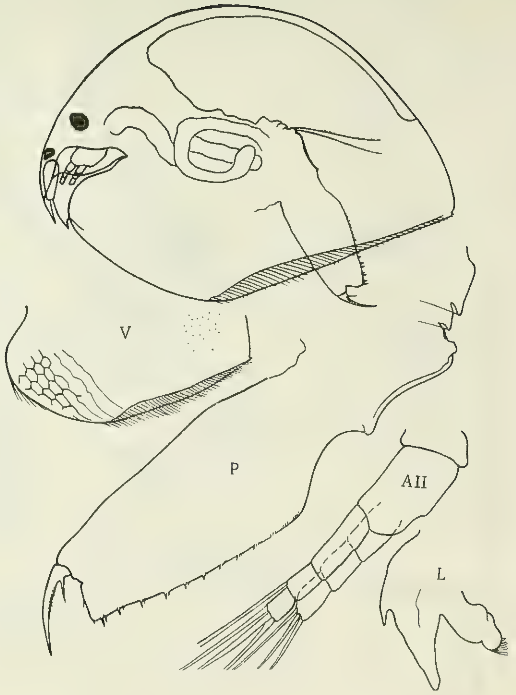

FIGURE 353. Chydorus brevidentatus, female, length 0.35 mm (White Nile, 19 April 1964). P – preparation 1826.

316 Male. Unknown.

Distribution. U.S.A. (New England).

20. **Chydorus brevidentatus** N. N. Smirnov sp. n.
(Figures 353, 354)

Material. Numerous females from the White Nile. Holotype: female, preparation 1826 (MGU). Paratype: ZIN – 53848, female (938).

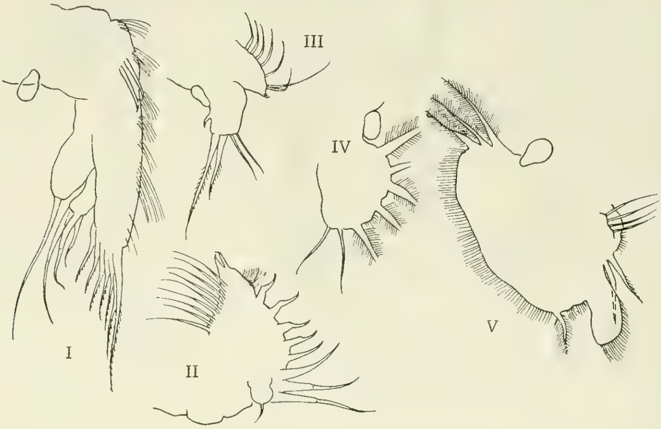

FIGURE 354. Legs of Chydorus brevidentatus, female, (White Nile, 19 April 1964):

I – left leg, inner view; II, IV – left legs, outer view; III, V – right legs, outer view.

Female. Ratio of length:height 1.4:1. Posterior margin of valve 2.8 times shorter than maximum height. Dorsal margin of valve uniformly convex, forming a smooth curve with dorsal margin of head. Ventral margin of valve convex in the middle. Behind this convexity is a row of setae beginning on inner side of valve. Posterodorsal corner indistinct. Posteroventral corner with small ridges. Valve with pattern of polygons anteriorly and dots posteriorly. Antennules ending slightly less than their length before apex of rostrum. Antennae not reaching apex of antennules or apex of rostrum. Setae on antennae: 0–0–3/0–1–3, spines absent. Plate of labrum with produced apex and with a single large denticle on the anterior margin.

Postabdomen long, slightly tapering apically. Preanal corner distinct but not strongly projecting. Anal margin concave. Postanal margin straight. Anal denticles small, decreasing in size proximally, in about 13 groups. Distal groups with 2 denticles; proximal denticle smaller than distal. In the proximal groups, distal denticle accompanied by setae.

Last proximal groups consisting of setae. Lateral setae absent. Distal margin of postabdomen straight, several times as wide as base of claws. Claws with a single basal spine.

Intestine forming loops. Ocellus smaller than eye, situated slightly nearer to eye than to apex of rostrum.

Leg I with 6 rows of setules on the anterior side. Outer branch of endite with 3 setae of different length (Figure 113). Other legs typical for the genus (Figure 354). Length about 0.35 mm.

Male. Unknown.

Systematic remarks. This species was placed in the genus Chydorus because of the presence of a row of setae beginning on the inner surface of the posterior half of the ventral margin of the valves. It differs from Ch. hybridus in the structure of the postabdomen, because the preanal corner does not project strongly and very long anal denticles are absent. It differs from Ch. breviceps because of the presence of a denticle on the anterior side of the plate of the labrum and the antennules do not reach the apex of the rostrum.

The name brevidentatus refers to the short denticles near the anus.

Distribution. White Nile.

318 21. **Chydorus breviceps** (Stingelin, 1905) comb. n.
(Figure 355)

Stingelin, 1905:354–355, Plate 13, Figure 29, 29a (Alonella).

This species was placed in the genus Chydorus because the row of setae begins on the inner side of the ventral margin of the valves, a character not mentioned by Stingelin (1905) but shown in his drawing. The form of the postabdomen resembles that of Ch. brevidentatus (Chiang Sieh-chih, 1963:259–262, Figures 18–19; according to some characters, Alonella brevirostrata may be considered as a synonym of Ch. brevidentatus, although the description gives no data on the arrangement of the setae on the ventral margin of the valve).

Material. According to description.

Female. Maximal height before the middle. Posterodorsal corner of valve indistinct. Posteroventral corner with a denticle. Valve with a pattern of hexagons; anterior margin with lines parallel to the margin. Rostrum short, pointed. Antennules projecting far beyond apex of rostrum. Setae on antennae: 0–0–3/0–1–3 (Chiang Sieh-chih, 1963). Plate of labrum smooth, tongue-shaped. Five pairs of legs. Postabdomen narrowing distally. About 15 anal denticles. Lateral setae absent. Claws with 2 basal denticles and with setae on the concave margin. Intestine forming loops. Ocellus situated halfway between eye and apex of rostrum. Length 0.4 mm.

Male. Unknown.

Distribution. Thailand. Hainan (according to Chiang Sieh-chih).

22. **Chydorus carolinae** Methuen, 1910 (Figure 356)

Methuen, 1910:157, Plate XVI, Figures 44a, b.

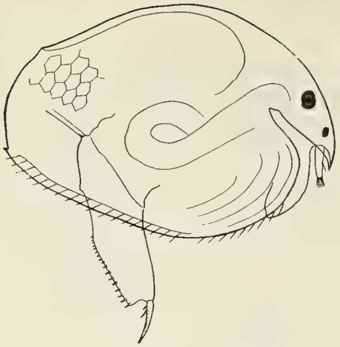

FIGURE 355. Chydorus breviceps, female (after Stingelin, 1905)

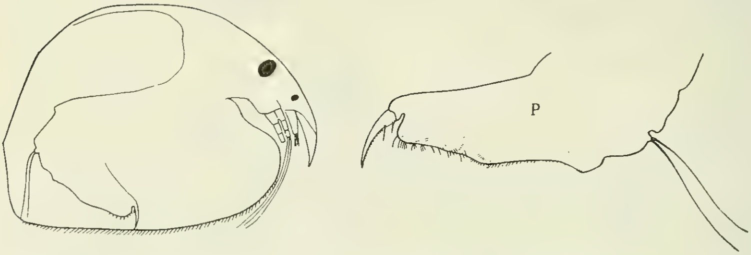

FIGURE 356. Chydorus carolinae, female (after Methuen, 1910)

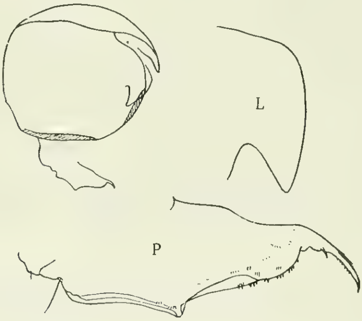

FIGURE 357. Chydorus godeti, female (after Delachaux, 1919)

Material. According to description.

Female. Ratio of height:length 1:1.3. Posteroventral corner of valves rounded, without denticles. Rostrum pointed. Antennules and antennae not reaching apex of rostrum. Postabdomen slightly tapering distally. Anal denticles thin, isolated and in irregular groups. Anal margin slightly concave, with setules. Lateral setae in 2 rows extending across abdomen. Possibly described after a specimen with malformed abdomen. Ocellus situated nearer to eye than to apex of rostrum.

Male. Unknown.

Distribution. South Africa.

23. **Chydorus godeti** Delachaux, 1919 (Figure 357)

Delachaux, 1919:31–32, Plate III, Figures 9–11.

Material. According to description.

Female. Body only slightly longer than high. Posteroventral corner of valve rounded, without denticles. Plate of labrum with convex anterior margin and pointed apex. Postabdomen tapering distally, preanal corner strongly projecting. Anal denticles in 5 groups of 3 denticles, continuing into row of groups of hairs to the preanal corner. Distal part of postabdomen with 2 groups of setae laterally which are parallel to the dorsal margin and one group of setae transversely. Claws with a single basal spine and with setae on the concave margin. Postabdomen possibly malformed. Length 0.5 mm.

Male. Unknown.

Distribution. Peru.

Species incertae sedis

Chydorus albicans (Gay, 1849):292 (Lynceus).

Chydorus ceylonicus Daday, 1898:26–27, Figure 8.

Chydorus clelandi Henry, 1919:481–482, Plate XLII, Figures 17, 18. The form of the plate of the labrum is not described, and it is therefore impossible to determine the status of this species, which occurs in Australia.

Chydorus gibsoni Brady, 1906:183, Plate XXXII, Figures 1, 2.

Chydorus latifrons Dana, 1852:351 (in the Proceedings of the American Acad. Sci., II, 1852 in the Moscow Society of Naturalists, Ch. latifrons is mentioned in the index, p. 351, with reference to p. 48, but its name does not appear on that page or on any other page); 1853:1274–1275; 1855 (Atlas), Plate 89, Figures 7a, b (Lynceus); Schoedler, 1858: 15–18; 1863:15–16; Herrick, 1884:118.

Chydorus macquariensis Brady, 1918:5–6, Plate XVII, Figures 17, 18, 19.

Chydorus minutus Thompson, 1879:262, Figure E3a.

Chydorus ovalis var. ludwinowianus Dybowski et Grochowski, 1895:153. Nomen nudum.

Chydorus striatus Klocke, 1893:388 (without description or drawing). Nomen nudum.

319 8. Genus Dunhevedia King, 1853

King, 1853:261; Birge, 1879:24–25 (Crepidocercus); Herrick, 1884: 91 (Crepidocercus); Sars, 1888:41; Sovinskii, 1891:53–54; Table II, Figures 33–36 (Alona); Dybowski and Grochowski, 1894:382 (Landea); Stingelin, 1895:259 (Crepidocercus); Vavra, 1900:21–22; Sars, 1901:75–76; 1916:343; Daday, 1910b:126; Bening, 1941:268–269; Šrámek-Hušek et al., 1962:383; Herbst, 1962:100.

Type species: Dunhevedia crassa King, 1853.

Body oval. Posterior part of ventral margin with setae on inner side of valves. Posteroventral corner with a large denticle (sometimes without denticle). Head pores typical for the subfamily. Distance from head pores to posterior margin of head shield shorter than distance between head pores. Setae on antennae: 0–0–3/0–1–3. Postabdomen wide, with convex dorsal margin with anal denticles. Claws of female with a single basal spine. Ocellus smaller than eye. Five pairs of legs. Leg I of normal structure. Leg II with uniformly hooklike setae. Exopodite of leg III with 4 setae on the posterior side and 3 short setae on the dorsal side. Leg IV with a rounded exopodite with 7 setae; the 2 anterior setae sparsely pubescent, the others feathered. Leg V with an oval exopodite with 4 setae, 1 on the anterior side, 3 on the posterior side.

The males are smaller than the females and differ from them in the morphology of leg I. Distribution between 60°N. and S. D. crassa has the widest distribution. D. serrata has a pantropical distribution.

Key to Species of Genus Dunhevedia according to Females

1 (6). Valves without a concavity in the middle in dorsal view.
2 (3). Plate of labrum without denticles . . . . 1. **D. crassa** King, 1853.
3 (2). Plate of labrum with denticles.
4 (5). Plate of labrum with a single denticle . . . 2. **D. odontoplax** Sars, 1901.
5 (4). Plate of labrum with numerous denticles . . . . 3. **D. serrata** Daday, 1898.
6 (1). Valves with a concavity in the middle in dorsal view . . . . 4. **D. podagra** King, 1853.

1. Dunhevedia crassa King, 1853

Smirnov, 1966c, Figure 18; Negrea, 1966a:148.

Female. Posteroventral corner of valve with a denticle 10–15 μ long. E. Kudelina (1930) stated that the posteroventral corner of the valve may bear 1, 2 or 3 denticles, but considers this as a variation and not as a specific character. According to Ponyi (1955), this is one of the main reasons for the establishment of D. crassa dvihalliana. There are populations of D. crassa in which some specimens have a denticle on the posteroventral corner of the valves and some do not. Ventral margin of valve with feathered setae which are longest in the middle. Maximum height slightly before the middle. Posterior margin of valve almost straight, 2.5 times shorter than maximum height. Valves with pattern of hexagons. Head shield with rounded anterior and posterior margin. Head pores typical for the subfamily.

Antennules thick, slightly tapering distally, ending slightly before apex of rostrum. Lateral sensory seta situated on a tubercle distal to middle of anterior margin of antennule. Setae on antennae: 0–0–3/0–1–3. Plate of labrum triangular, with pointed apex; anterior margin slightly concave, without denticles.

Postabdomen usually oval. Postabdomen with 15–18 anal denticles. Numerous lateral groups of setae. Anus situated on the concave proximal margin of the postabdomen (on the functionally posterior side of the postabdomen). Claws with a basal spine and with setae on the concave margin.

Ocellus situated slightly nearer to eye than to apex of rostrum. Width of eye to 35 μ, of ocellus to 20 μ.

Legs usually typical for the subfamily. Endite of leg I with 3 setae on the outer branch. Anterior part of inner branch of endite with 4 setae, posterior part with 3 setae. Posterior side of endite with 4 setae, the last seta curved and directed at a right angle to the stem of the endite.

Endite of leg III divided (Figure 44). The part near the gnathobase with 5 small setae and a sensilla. The part farther from the gnathobase (near the exopodite) with 3 thin, long setae which decrease in length toward the gnathobase. Endite with 6 soft setae. Gnathobase with a fan of 8 filtering setae.

Leg IV with a rounded exopodite with 7 setae. Endite of leg IV with 4 hard setae and with a sensilla more proximally. Endite with 4 soft setae. Endite of leg V with an oval exopodite with 4 setae. Endite of leg V lobed, with 2 hard setae. Filtering fan of gnathobase consisting of 4 setae. Length to 0.55 mm.

320 Male. Body oval. Dorsal and ventral margin strongly and similarly convex. Posterior margin straight. Ratio of length:height nearly 3:2. Posterior margin slightly more than half of maximum height. Posterodorsal corner of valve distinct. Posteroventral corner with a denticle. Head shield passing smoothly into dorsal margin of valves.

Antennules not reaching apex of rostrum. Plate of labrum with rounded anterior margin and pointed apex. Postabdomen resembling that of female, but there is a process ventral to the claw on which the vas deferens opens. Length to 0.36 mm.

Biology. Lives in vegetation, especially in rice fields. Tolerates salinization up to 25.9‰ (Kudelina, 1930).

Key to Subspecies of D. crassa according to Females

1 (6). Dorsal margin of postabdomen without incision.
2 (5). Anterior margin of labrum without tubercle-shaped convexity.
3 (4). Antennules with sensory papillae of at most half the length of the antennule . . . . 1a. **D. crassa crassa** King, 1853.
4 (3). Antennules with sensory papillae as long as the antennule . . . . 1b. **D. crassa dvihilliana** Ponyi, 1955.
5 (2). Anterior margin of labrum with a tubercle-shaped convexity . . . . 1c. **D. crassa cilio-caudata** (Sovinsky, 1891).

6 (1). Dorsal margin of postabdomen with an incision . . . . 1d. D. crassa eureticulata, Kottász, 1913.

1a. Dunhevedia crassa crassa King, 1853 (Figures 358–361)

King, 1853:261, Plate VII, F (crassa); Birge, 1879:26, Plate I, Figure 18 (Crepidocercus setiger); Stingelin, 1895:259–260, Plate VIII, Figure 42 (C. setiger); Sars, 1903a:185–186, Plate VIII, Figure 5 (D. setigera); Grochmalicki, 1915:227–228, Plate 6, Figures 9a, b (siedleckii); Sars, 1916:343–344, Plate XLI, Figures 3, 3a–c (crassa); Birge,
322 1918:725, Figure 1134 (setigera); Bening, 1941:269–271, Figure 111 (crassa); Einsle, 1959:62–64 (crassa); Frey, 1959:38–39, Figure 49 (crassa); 1962a, Figure 49 (crassa); Šrámek-Hušek et al., 1962:283, Figure 144 (crassa); Herbst, 1962:100, Figure 84 (crassa).

Material. Several females from the following localities: a pond at the Bug liman, Lake Bugun-Kul' in the Aktyubinsk Region, the White Nile, the Blue Nile near Rusayris, Lake Ras Amer in the upper reaches of the Nile, Queensland and South Australia. Preparations: MGU – female 1588. ZIN– female 1586.

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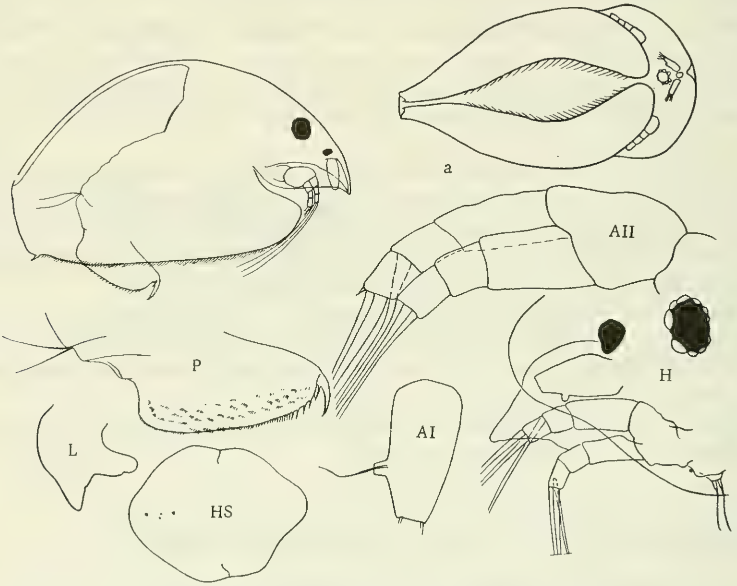

FIGURE 358. Dunhevedia crassa crassa, female, length 0.44 mm:

P, L – puddle in the Kiev region, 5 June 1961; HS – after Frey, 1962a; a – ventral, after Sars, 1916; AII – left antenna, outer side (puddle at the Bug liman, 23 June 1963); AI – right antennule, inner side; H – head, dorsal (Dawson Creek, Queensland, Australia, 18 July 1965).

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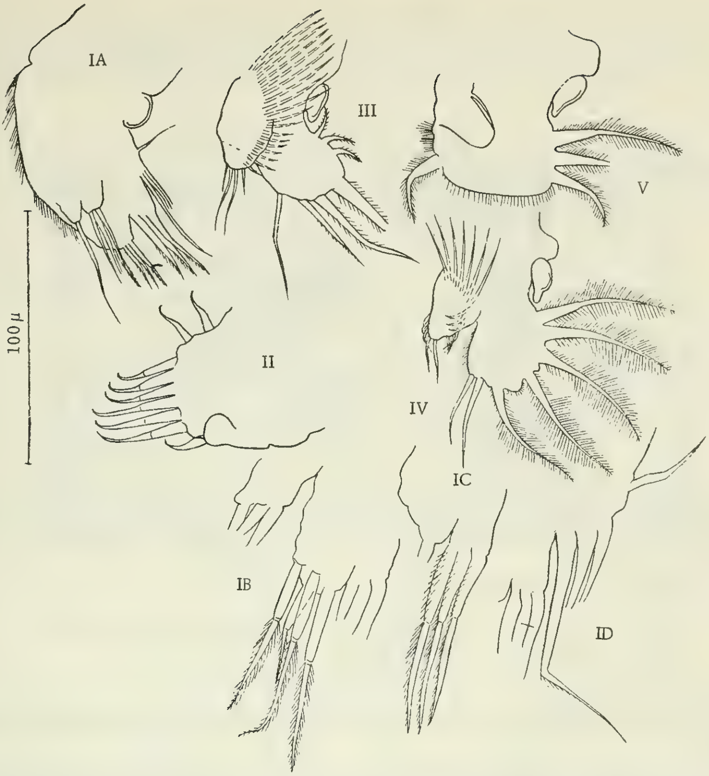

FIGURE 359. Legs of female of Dunhevedia crassa crassa, left side (puddle near Bug liman, 23 June 1963):

IA, III, IV, V — outer side; II — inner side; IB, IC, ID — setae of inner branch of endite (Dawson Creek, Queensland, Australia, 18 July 1965).

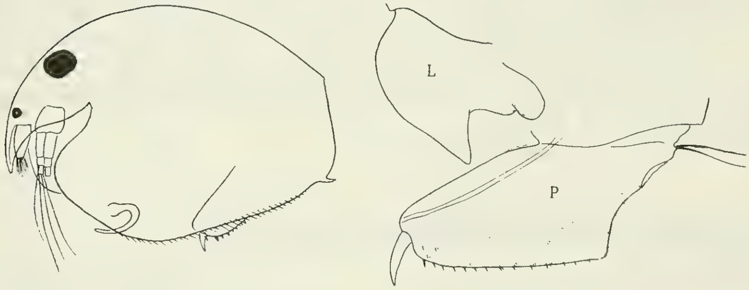

FIGURE 360. Dunhevedia crassa crassa, male (after Gauthier, 1928b)

Female. Labral plate without tubercle-shaped process. Posteroventral corner of valve with one denticle. Sensory papillae of antennules at most half as long as antennule. Length of female to 0.55 mm.

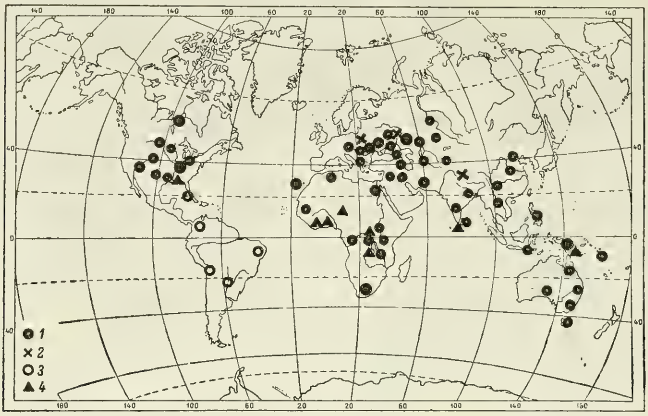

FIGURE 361. Distribution:

1 – Dunhevedia crassa crassa; 2 – D. crassa cilio-caudata; 3 – D. odontoplax; 4 – D. serrata.

Male. Antennules reaching apex of rostrum. (Birge, 1892). Length 0.32 mm.

Distribution. Holarctic Region (south of 60°N), Ethiopian, Indo-Malayan and Australian regions. Southern part of European USSR, to the Ob' in the east.

1b. **Dunhevedia crassa dvihalliana** Ponyi, 1955 (Figure 362)

Ponyi, 1955:315–316, Figures 4, 5, 6.

Female. Plate of labrum without tubercle-shaped process. Six–ten distal anal denticles in the form of spines directed posteriorly. Posteroventral corner of valve with a large denticle and a small denticle above it. The small denticle is sometimes present only on one valve or absent and replaced by a small process. Sensory papillae of antennule as long as antennule. Length to 0.6 mm.

Distribution. Hungary.

1c. **Dunhevedia crassa cilio-caudata** (Sovinsky, 1891) (Figures 361, 363)

Sovinskii, 1891:159–160, Plate III, Figures 33–36 (Alona cilio-caudata); Daday, 1904a:62–64, Plate 5, Figures 6–8 (neglecta); Brehm, 1936b:290–291, Figure 2c (var. interrupta syn. n.).

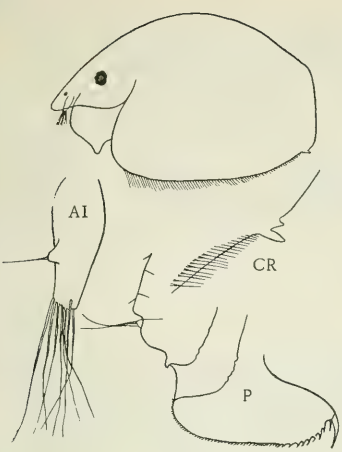

FIGURE 362. Dunhevedia crassa dvihalliana, female (after Ponyi, 1955)

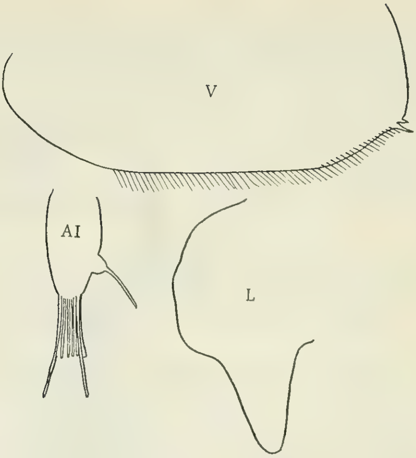

FIGURE 363. Dunhevedia crassa ciliocaudata, female (after Sovinskii, 1891)

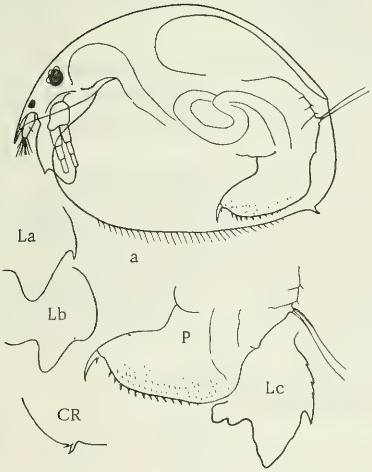

FIGURE 364. Dunhevedia odontoplax, female:

a, P — after Sars, 1901; Cr, La, Lb — after Harding, 1955; Lc — after Stingelin, 1913.

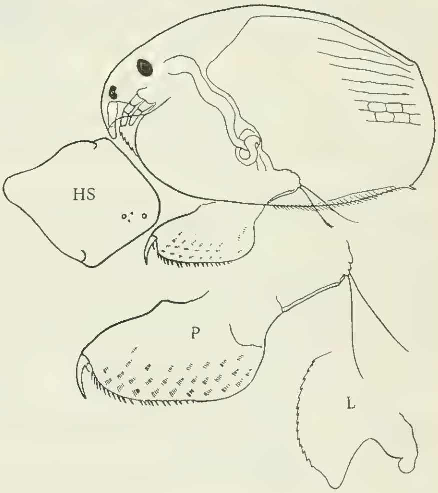

FIGURE 365. Dunhevedia serrata, female, length 0.51 mm (White Nile, Sobat, 26 December 1963):

HS — after De Costa, 1964; P — preparation 2075.

Female. Posteroventral corner of valves with a denticle, sometimes with an accessory denticle above it. Anterior margin of plate of labrum with a strong convexity and blunt apex. Two sensory papillae longer than the others. Postabdomen with 11–12 anal denticles and with transverse rows of setae almost on the whole surface. Ocellus about a quarter as large as the eye, situated halfway between eye and apex of rostrum. Length to 0.5 mm.

Distribution. Poland, North India. USSR: Kiev region.

1d. **Dunhevedia crassa eureticulata** Kottász, 1913

Kottász, 1913:92 (var. eureticulata).

324 Kottász gives the following description: "This new variety differs from the type form in the morphology of the rostrum, the plate of the labrum, the valve, and in the very characteristic concave postabdomen. On the lower (dorsal) margin of the postabdomen there is a large blunt incision (this part is convex in the type form); the margin of the incision bears 11 anal denticles, and almost parallel to the margin are lateral setae in groups of 3–4. Typical habitat: Albertfalva (near Budapest).

2. **Dunhevedia odontoplax** Sars, 1901 (Figures 361, 364)

Vavra, 1900:22, Figure 5 (non Birge) (setigera); Sars, 1901:76, Plate XI, Figures 6, 6a, 6b; Stingelin, 1913:625, Figures 26–27 (var. colombiensis); Harding, 1955:347, Figures 73–78.

Material. British Museum 73. 1954. 8.9436–448 (Lake Titicaca).

Female. Valves with weak reticulation. Posteroventral corner of valve with a denticle. Plate of labrum with a denticle in middle of anterior margin.

According to Harding (1955) the posteroventral corner of the female bears a denticle, and there may be an accessory denticle behind it. Labrum with a denticle on the anterior margin. The forms illustrated by Harding may have a plate of the labrum with a tubercle on the anterior margin (Figure 75), and this may be a little developed denticle; in this case, these forms belong to D. odontoplax and not to D. crassa. Antennules ending slightly before apex of rostrum.

Postabdomen usually oval. Anal denticles small. Lateral setae numerous. Claws with a basal spine. Length 0.46 mm.

Male. Unknown.

Distribution. Neotropical Region.

3. **Dunhevedia serrata** Daday, 1898 (Figures 44, 361, 365, 366)

Daday, 1898:32–33, Figure 13; 1910b:126–127, Plate 6, Figure 26, 27, 28; Rahm, 1956:252–253, Figure 10; Harding, 1957b:81, Figures 39–42.

Material. Numerous females from the White Nile. Preparations: MGU – female 2075. ZIN – female 2078. Ph – female 2079.

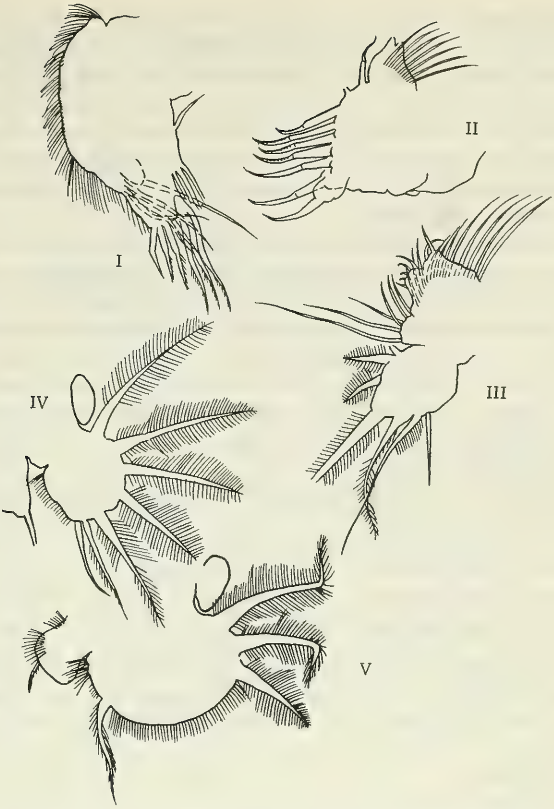

FIGURE 366. Legs of Dunhevedia serrata, female (White Nile, Sobat, 26 December 1963):

I, II, IV, V — right legs, inner view; III — left leg, inner view.

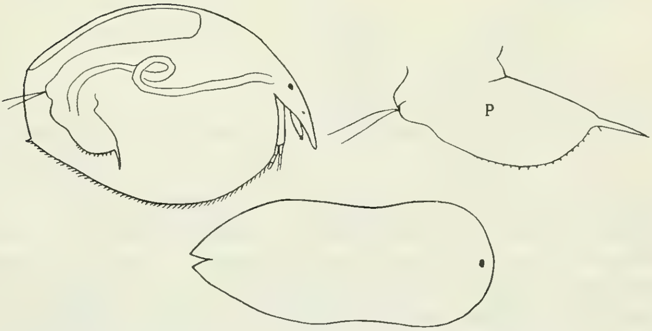

FIGURE 367. Dunhevedia podagra, female (after King, 1853)

Female. Length 1.6 times maximum height. Valves with distinct posterodorsal corner. Posteroventral corner with 2 denticles, dorsal denticle smaller than ventral. Valves with longitudinal lines and dots. Rostrum blunt. Head pores typical for the subfamily. Plate of labrum with serrated anterior margin, with 10–15 denticles, the apical denticles directed downward; plate of labrum with bifid ventral end. Postabdomen with numerous lateral groups of setae. Claw with a basal spine and with setae on the concave margin.

Legs typical for the genus. Leg III with endite with 8 hard setae in 2 groups. One of the groups consists of setae 6, 7, and 8, which are straight and thin, setae 7 and 8 long, about twice as long as seta 6. The other group, near the gnathobase, consists of setae 1–5 which are of about equal length; setae 1, 2, and 3 are slightly curved, setae 4 and 5 straight. Endite with a row of 6 soft setae. Gnathobase with a filtering fan of 8 setae.

Ocellus of female smaller than eye and situated halfway between eye and apex of rostrum. Length to 0.8 mm.

Male. Unknown.

Distribution. Africa, Ceylon, New Guinea, North America (Figure 361).

4. Dunhevedia podagra King, 1853 (Figure 367)

King, 1853:261, Plate VIIE.

Material. According to description.

Female. Outline of body dorsally concave in the middle. Posteroventral corner of valve with a denticle. Antennules not reaching apex of rostrum. Ocellus smaller than eye, situated halfway between eye and apex of rostrum.

Male. Unknown.

Distribution. Australia.

Nomen nudum

Dunhevedia syrenopolitana (Dybowski and Grochowski, 1894). Dybowski and Grochowski, 1894:382; 1895:151 (Landea syrenopolitana). Nomen nudum.

9. Genus Dadaya Sars, 1901

Daday, 1898:38 (Alona); Sars, 1901:73; Daday, 1910b:126; Bergamin, 1940:100.

Type species: Dadaya macrops (Daday, 1898).

Outline of body oval. Rostrum pointed. Head shield with rounded posterior margin. A single head pore. Posterior part of ventral margin
326 of valves with setae on inner side of valve. Valve reticulate. Antennules projecting distinctly beyond apex of rostrum. Setae on antennae: 0–0–3/0–1–3. Plate of labrum with pointed apex. Postabdomen without lateral denticles. Ocellus and eye unusually large. Postabdomen without lateral setae, with anal denticles. Claws with a single basal spine. One species.

Sars (1901:73) stated that the scarcity of material prevented him from examining the morphology of the legs in detail and that the male is unknown. New data on the legs prove that Dadaya belongs to the subfamily Chydorinae.

Leg I with rows of setae on anterior side of endite. Leg II with long thin setae on the endite. Leg III with rectangular exopodite with 4 setae on the posterior side and 3 setae on the dorsal side. Setae of posterior margin less than twice as long as the exopodite, setae of dorsal margin shorter than exopodite. Leg IV with a rounded exopodite with 7 setae. The 2 anterior setae are apparently not pubescent, the other setae are pubescent Seta 5 is the shortest. Lev V with an oval large exopodite with 4 setae, 1 of them on the anterior side, the other 3 on the posterior side.

1. **Dadaya macrops** (Daday, 1898) (Figures 368–370)

Daday, 1898:38–39, Figure 17 (Alona); Sars, 1901:73–74, Plate XI, Figures 5a, 5b; Daday, 1910b:126; Brehm, 1933a:746–747, Figures 40–41; Bergamin, 1939, Plate II, Figure 1; 1940:100, Figure 19 (ocellata); 101, Figure 20 (macrops) (ocellata, Bergamin, 1931 – reference to unpublished dissertation of Bergamin, F., 1931, Estudio systematico des Cladocera des aguas do municipio de S. Paulo. Thèse inaugural); Brehm, 1953b:339–340, Figure 106; Rahm, 1956:256, Figures 11, 12; Fryer, 1956: 733–734, Figures 1, 2; Smirnov, 1966c, Figure 20.

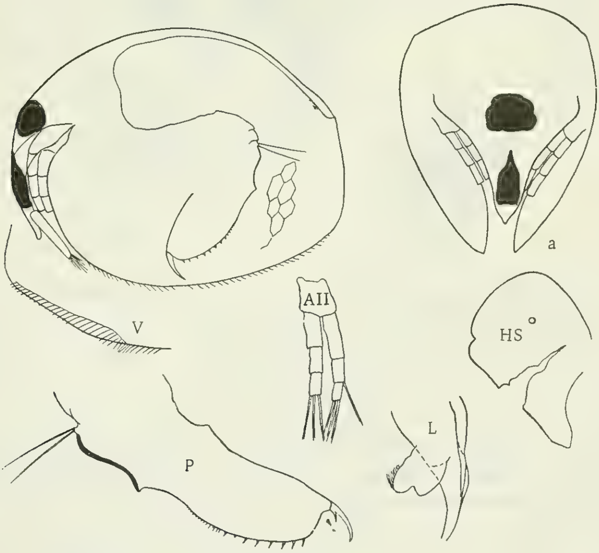

FIGURE 368. Dadaya macrops, female, length 0.35 mm (Gayndah, Queensland, Australia, 29 October 1964):

L – labral plate posterior view, left side; a – anterior view.

Material. Numerous females from the White Nile; several females from a pond near Gayndah (Queensland, Australia). Preparations: MGU – female 1739. ZIN – female 1738.

(327)

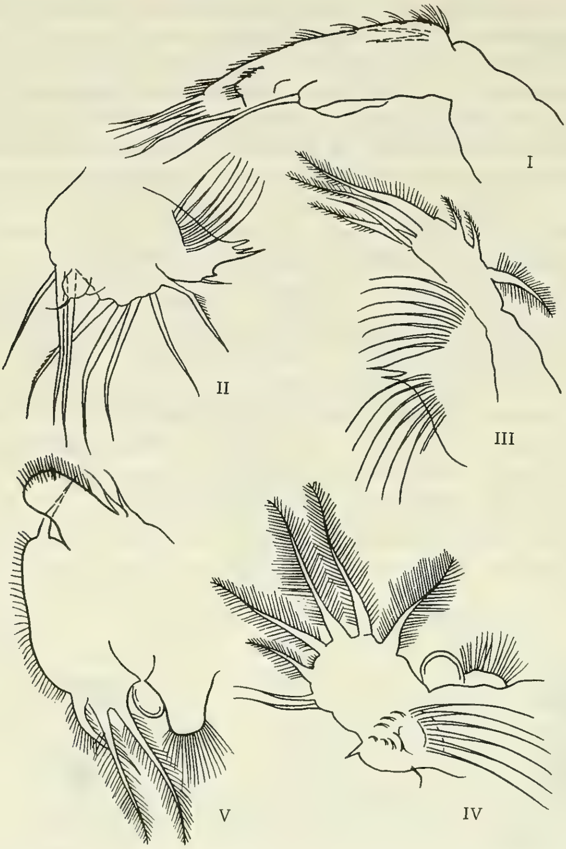

FIGURE 369. Legs of Dadaya macrops, female, left side (Gayndah, 29 October 1964):

I, II, V – outer view; III, V – inner view.

Female. Dorsal and ventral margin of valves convex. Ratio of height:length 1:1.3. Posteroventral corner of valve rounded, with or without a denticle (as illustrated by Daday, 1898 and Sars, 1901). Ventral mar-
327 gin of valve with setae on inner side of valves in the posterior half of ventral margin. Valves with pattern of hexagons. Rostrum long. Head pore single, small. Antennules projecting markedly beyond apex of rostrum. Distal segments of antenna not reaching apex of rostrum. Setae on antennae: 0–0–3/0–1–3.

Labrum of characteristic form with a long, beaklike process (Figure 368).

Postabdomen with projecting preanal corner. More than 10 anal denticles, the proximal denticles very small. Claw with a basal spine. Ocellus and eye very large.
(328)

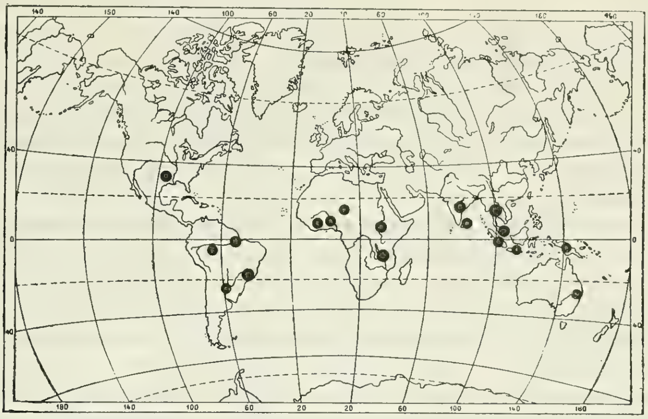

FIGURE 370. Distribution of Dadaya macrops

Legs typical for the subfamily. Outer branch of endite of leg I small, displaced to the base of the leg, with 3 thin setae of different length (Figure 110). Hard hook-shaped setae on endite of leg II and III thin, long. Length to 0.41 mm.

Male. Unknown.

328 Distribution. Ethiopian, Indo-Malayan, Australian and Neotropical regions (reported from Australia by N. N. Smirnov (1966c)).

Biology. Inhabits the surface.

10. Genus Pseudochydorus Fryer, 1968

Lilljeborg, 1900:549 (Chydorus, part); Fryer, 1968:323–324.

Type species: Pseudochydorus globosus (Baird, 1893).

Body spherical. Ventral margins of valves closed without a gap. Ventral setae of valve situated on inner surface of valve its whole length, those in the posterior half at a distinct distance from the margin. Rostrum pointed.

Postabdomen narrow, with anal denticles and groups of lateral setae. Claws with 2 basal spines, distal spine large. Ocellus smaller than eye.

Legs II–V with nonfiltering setae. According to Fryer (1968), the gnathobase of legs II and III with 5 setae, that of leg IV with 4 setae. Gnathobase of leg V with 3 setae.

In P. globosus the seta near the epipodite on the dorsal side of the exopodite of leg III is much longer than the two other setae as it closes the gap between legs III and IV longitudinally. This seta is directed upward but belongs to the pump chamber. This seta is reversely feathered;

although it has the same function as the other setae, its orientation is the opposite. This is explained by the fact that the setules of the seta are pointed in the same direction as those of the setae which are directed posteriorly.

1. Pseudochydorus globosus (Baird, 1893)

Female. Slightly longer than high. Ratio of height :length 1:1.3. Posteroventral corner rounded, without denticles. Surface sometimes with brown spots of varying form (not to be confused with ephippial Chydorus sphaericus).

Rostrum pointed, directed ventrally. Head shield with rounded posterior margin. Head pores typical for the subfamily. Anterior ventral part of valve with concentric stripes and behind them hexagonal cells. Antennules not reaching apex of rostrum. Anterior margin of antennule with a sensory seta in the distal half. Esthetascs on the obliquely truncate distal margin. Setae on antennae: 0–0–3/1–1–3, spines 0–0–1/0–0–1. Labrum without plate-shaped process. Postabdomen narrow, almost uniformly wide. Dorsal distal corner produced in old females. Anal margin with setae. Groups of lateral setae present. Anal denticles 20–30, decreasing in size
329 proximally. Claws with a row of setae on the concave margin and with 2 basal denticles. Ocellus situated nearer to eye than to apex of rostrum.

Outer branch of endite of leg I with 2 strong hook-shaped setae of different length and a longer thin seta. Anterior margin of leg I with 3 pairs of needle-shaped setae on the distal corner. Leg III with very large exopodite with a large, reversely feathered dorsal proximal seta.

Length, according to specimens from the Gorki Reservoir (1 August 1960), 0.37 (1st stage) to 0.65 mm; minimal length of gravid females 0.42 mm (3rd stage). Two rows of groups of setae on each side.

Male. Antennules with 2-segmented flagellum in middle of anterior margin and with a sensory seta slightly proximal to the flagellum. Antennules not reaching apex of rostrum. Esthetascs 9, situated on apex of antennule. Anus situated in a deep depression. Dorsal distal margin of postabdomen with anal denticles and 6–7 groups of setae proximal to them. Claw with 2 basal spines.

Outer branch of endite of leg I with 4 setae of different length and with a hook. Endite of leg IV with 3 hard, straight setae; seta 8 large, seta 7 one quarter as large, seta 6 half as large. Row of soft setae on endite consisting of 4 short setae. Gnathobase with filtering fan of 5 setae. The large seta on apex of gnathobase curved at the base and its end directed toward the end of the hard seta 8 of the endite. Vas deferens opening between the claws. Length 0.65 mm.

Key to Subspecies of P. globosus according to Females

1 (2). Valve not pitted . . . . 1a. **P. globosus globosus** Baird, 1843.
2 (1). Valve pitted . . . . . . 1b. **P. globosus caelatus** Werestschagin, 1912.

1a. Pseudochydorus globosus globosus Baird, 1843
(Figures 349, 371, 376)

Baird, 1843:90, Plate III, Figures 1–4 (Chydorus globosus); Fischer, 1851:193, Plate X, Figure 3 (Lynceus tenuirostris); King, 1853:258, Plate VIIB (Chydorus augustus); Lilljeborg, 1853:85, Plate VII, Figure 11 (Lynceus); Leydig, 1860:230 (Lynceus globosus); Schoedler, 1862:13–14 (Chydorus globosus); Brady, 1868:423, Figure 7 (Lynceus globosus); P.E. Müller, 1867:195, Plate IV, Figure 25 (Chydorus globosus); Stingelin, 1895:26 (Chydorus globosus); Dybowski and Grochowski, 1898b, 5:153 (Ch. globiformis syn.n.; Chydorus globiformis was synonymized after examination of the type from the Western Ukraine, deposited at L'vov University Zoological Museum (tubes with several specimens)); Lilljeborg, 1900:547–552, Plate XXV, Figures 18–27, Plate XXVI, Figure 1 (Chydorus globosus); Shikleev, 1930a:317–318, 320–321, Figure 5 (Chydorus paradoxus syn.n., synonymyzed according to description and figures); Bening, 1941:326–328, Figure 135 (Chydorus globosus); Frey, 1959:40, Figure 66 (Chydorus globosus); 1962a, Figure 66 (Chydorus globosus); Šrámek-Hušek et al., 1962:386–388, Figure 145 (Chydorus globosus); Herbst, 1962:100–102, 85 (Chydorus globosus); Negrea, 1966a:148 (Chydorus globosus); Fryer, 1968:324–328, Figures 92–111; Rey and Saint-Jean, 1968:115, Figure 31 (Chydorus globosus).

Material. Numerous females from the Uglich, Rybinsk and Cherepovets reservoirs and from Queensland, Australia; several females from the White Nile; one female from a lake in the Terek delta and from Lake Karmak-Kul' in the Aktyubinsk Region. Numerous males from the Cherepovets Reservoir. Preparations: MGU – females 669, 660, 663, 673, male 679. ZIN – female 663, male 1823. Ph – female 300, male 678.

Female. Valve not pitted, with pattern of polygons and partly with lines.

Distribution. Holarctic, Ethiopian, Indo-Malayan and Australian regions. European USSR, to the Enisei in the East.

Biology. Lives in vegetation.

1b. Pseudochydorus globosus caelatus Werestschagin, 1912

Vereshchagin, 1912c:130 (Chydorus globosus var. caelatus). var. caelatus).

Female. Valves with 3–5 rows of pits on the ventral margin.

Distribution. Western Belorussia.

11. Genus Anchistropus Sars, 1862

Sars, 1862:290–291; Schoedler, 1863:76; Lilljeborg, 1900:585–587; Bening, 1941:342–343; Šrámek-Hušek et al., 1962:402–403; Herbst, 1962:104.

Type species: Anchistropus emarginatus Sars, 1862.

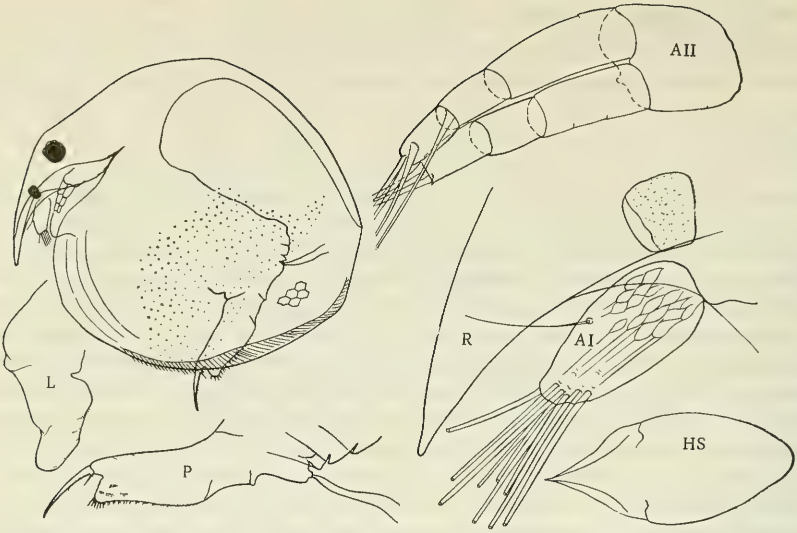

FIGURE 371. Pseudochydorus globosus globosus, female, left side:

P — length 0.72 mm (Sutka River, 11 August 1962); L — Cherepovets Reservoir, 10 September 1963; AII — right antennule, inner side; R, AI — apex of rostrum and left antennule, outer side, Cherepovets Reservoir, the mouth of the Kovzha River, 20 October 1963); HS — after Frey, 1962a.

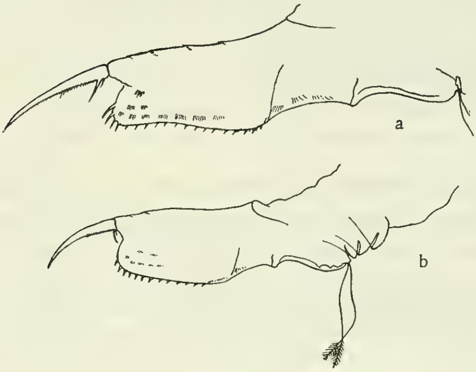

FIGURE 372. Postabdomen of female of Pseudochydorus globosus globosus (Cherepovets Reservoir above Goritsy, 10 September 1963):

a — of a specimen 0.67 mm long; b — of a specimen 0.49 mm long.

(331)

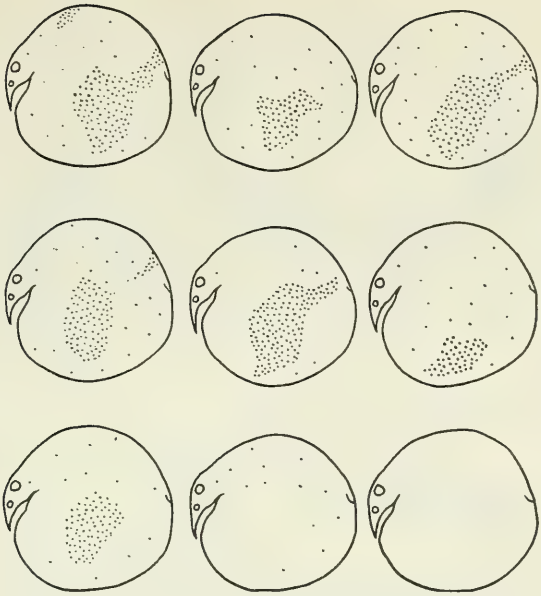

FIGURE 373. Pseudochydorus globosus globosus, female:

Variation of coloration: sparse dots — yellow; dense dots — brown (tributary of Volga pool of Rybinsk Reservoir; colorless specimen freshly molted).

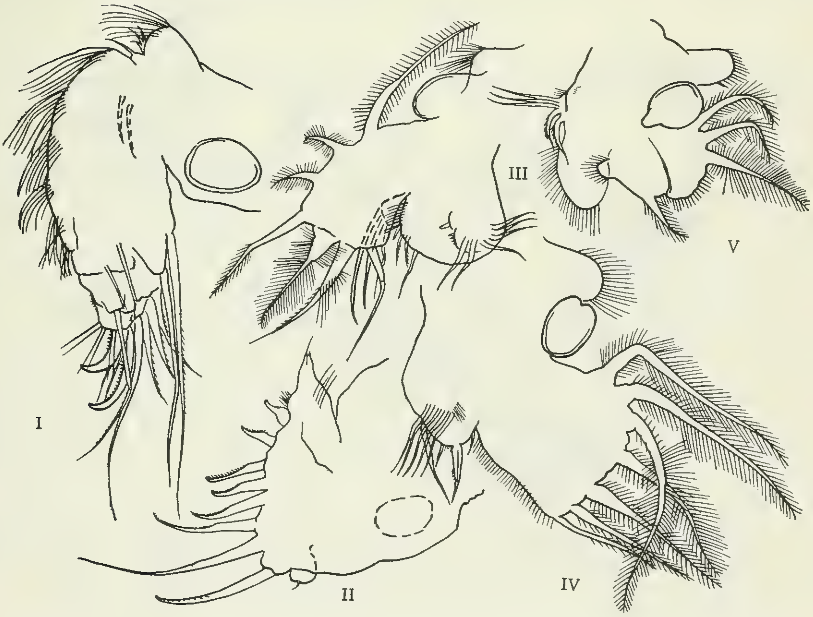

FIGURE 374. Legs of female of Pseudochydorus globosus globosus, left side (Cherepovets Reservoir, the mouth of the Kovzha River, 20 October 1963):

I, IV, V — outer side; II, III — inner side.

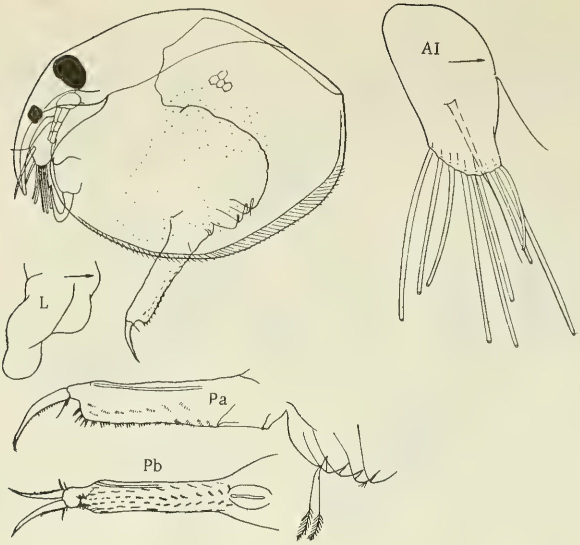

FIGURE 375. Pseudochydorus globosus globosus, male length 0.55 mm (Cherepovets Reservoir above Goritsy, 10 September 1963):

AI – left antennule, inner side; Pa – from the left side; Pb – from the dorsal side.

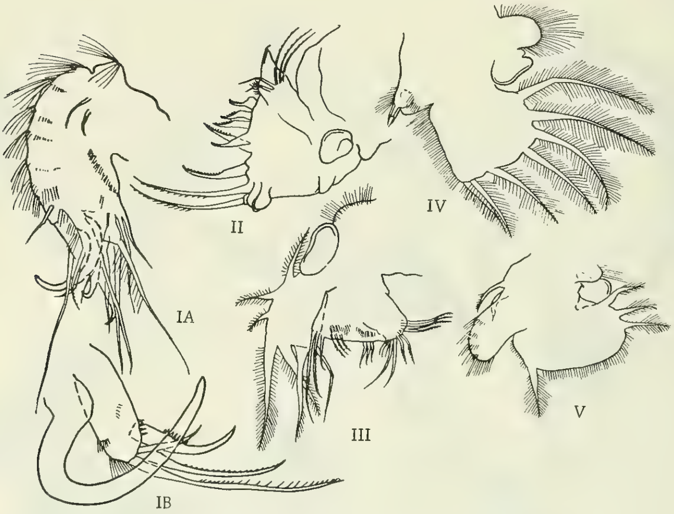

FIGURE 376. Legs of male of Pseudochydorus globosus globosus, right side (Cherepovets Reservoir above Goritsy, 10 September 1963):

IA – inner side; IB – outer lobe of endite, outer side; II, III, IV, V – outer side.

Body rounded. Posterodorsal and posteroventral corners of valves rounded, without denticles. Ventral margin of valve with an incision before the middle; behind the incision a process on the apex of which opens a gland. Ventral margin straight further posteriorly and covered with setae
333 on the inner side. Rostrum pointed. Head shield with rounded posterior margin. Head shield with 2 separate main pores and between them 2 small pores (Frey, 1959, 1962a). Antennules not reaching apex of rostrum. Setae on antennae: 0–0–3/0–1–3. Vas deferens opening at base of claws.

According to Lilljeborg (1900) there are 5 pairs of legs. Leg I with a well developed denticulate, hook-shaped seta. Leg II with little differentiated setae on the endite. Leg III with a square exopodite with 4 setae on the posterior side. Leg IV with a rounded exopodite with 7 setae. Leg V is illustrated in Lilljeborg as modified, consisting of several lobes. Epipodites without processes.

Key to Species of Genus Anchistropus according to Females

1 (2). Length to 0.46 mm. Eurasia . . . . 1. A. emarginatus Sars, 1862.
2 (1). Length to 0.36 mm. North America . . . . . 2. **A. minor** Birge, 1893.

1. Anchistropus emarginatus Sars, 1862 (Figures 377–380)

Sars, 1862b:290–291; Norman and Brady, 1867:405–406, Plate XIX, Figure 4, Plate XX, Figure 4; Lilljeborg, 1900:587–591, Plate LXXIX, Figures 7–21; Thiébaud, 1908:85–86, Plate 5, Figures 6, 7, 8; Bening, 1941:343–344, Figure 143; Šrámek-Hušek et al., 1962:404, Figure 152; Herbst, 1962:104, Figure 93; Negrea, 1966a:150.

Material. Three specimens from lakes in the floodplain of the Vychegda River. One specimen from the Angara River in the Irkutsk Region. One specimen from the mouth of the Never (Amur basin). Preparations: MGU – 1629. ZIN – 1059.

Female. Body almost as high as long. Valves with pattern of polygons. Antennules half as long as rostrum, with a sensory seta in middle of anterior margin. Antennae with spines on proximal segment of exopodite and on both distal segments. Plate of labrum nearly oval, with rounded posterior end. Postabdomen tapering distally. Distal dorsal margin with 2 rows of 10–12 denticles, its apex projecting beyond base of claws.

Postabdomen with 2 rows of groups of setae on each side (according to illustration of Hartwig, 1897b). Claws with setae on the concave margin. Intestine forming loops, with a caecum. Ocellus situated nearer to eye than to apex of rostrum. Legs typical for the subfamily, but leg I with a large hook-shaped seta and leg V modified (Lilljeborg, 1900). Length to 0.46 mm.

Male. Body slightly longer than high. Valves with distinct posterodorsal corner. Posteroventral corner rounded, without denticles. Rostrum hook-shaped posteriorly. Antennules with 2-segmented flagellum and with a sensory seta in middle of anterior margin. Leg I with a hook and with a large hook-shaped seta on outer part of endite. Length to 0.38 mm.

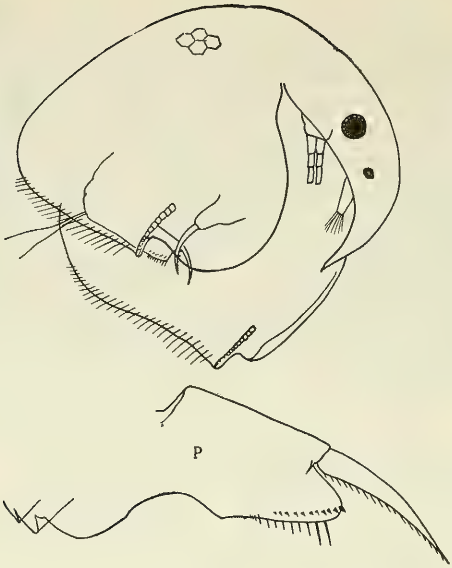

FIGURE 377. Anchistropus emarginatus, female, length 0.4 mm (Angara, Irkutsk Region, 23 August 1952):

P — lake in mouth of the Never River, Amur basin, 21 July 1957, preparation 1059.

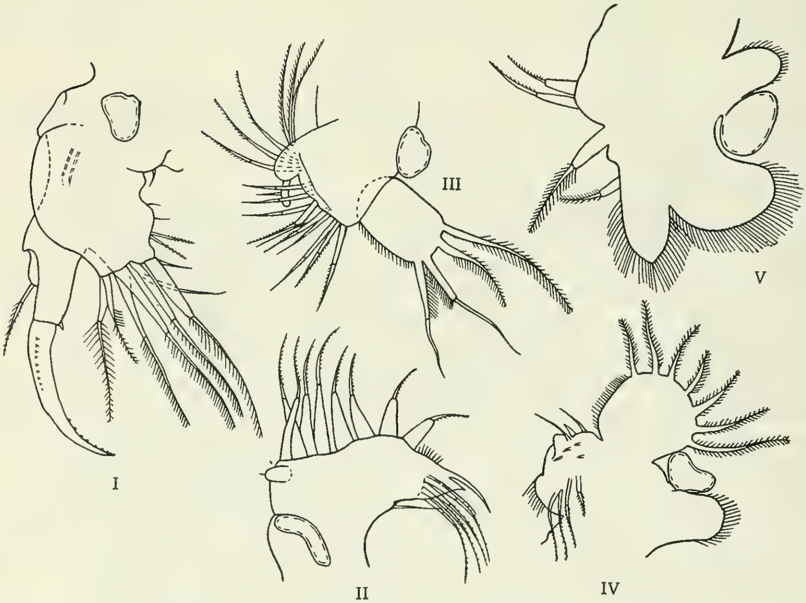

FIGURE 378. Legs of Anchistropus emarginatus, female (after Lilljeborg, 1900): I, III, V — left legs, outer side; II — right leg, outer side; IV — left leg, inner side.

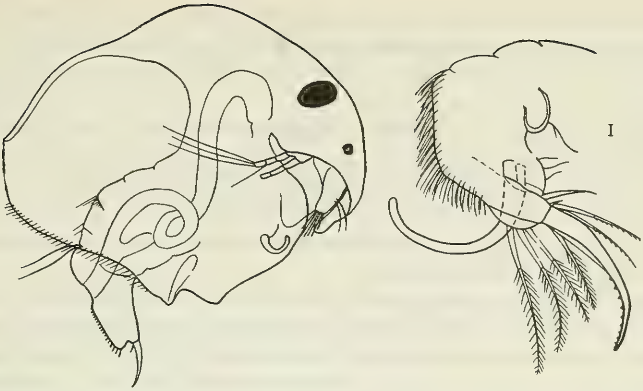

FIGURE 379. Anchistropus emarginatus, male (after Lilljeborg, 1900)

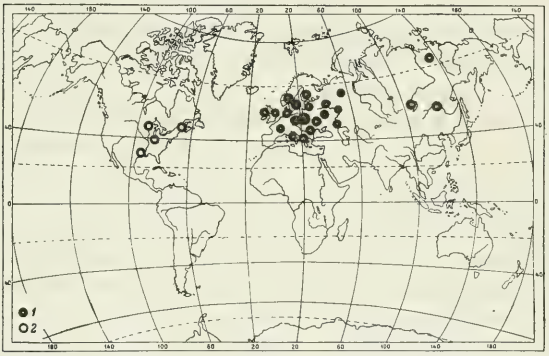

FIGURE 380. Distribution:

1 — Anchistropus emarginatus; 2 — A. minor.

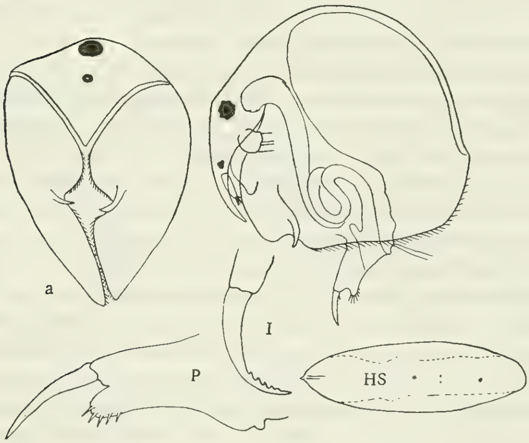

FIGURE 381. Anchistropus minor, female:

a — anterior view; P, I — after Birge, 1893; HS — after Frey, 1962a.

Distribution. Palearctic. European USSR, Baikal area, Amur basin.

Biology. Lives and feeds on hydrae.

2. Anchistropus minor Birge, 1893 (Figures 380, 381)

Birge, 1893:309–311, Plate XIII, Figures 2–5; Frey, 1959:40, Figures 67, 68; 1960:696, Figures 29, 30; 1962a, Figures 67–68.

Material. One female from Newfound Lake, New Hampshire, U.S.A. Preparation MGU – female 2523.

Female. Body only slightly longer than high. Posteroventral corner of valves rounded, without denticles. Rostrum pointed. Head with a convexity near the eye. Valves leaving a rhomboidal gap in anterior part of ventral margin. Antennules with a sensory seta and esthetascs of the same length. Antennae without spines. Head shield and valves reticulate, cells with undulate margin (Frey, 1960). Head pores typical for the subfamily. Postabdomen with prolonged dorsal distal end. Claws with a basal spine. Preanal corner projecting. Intestine forming loops, with a caecum. Leg I of female with thick hook-shaped seta. Length about 0.36 mm.

Male. Unknown.

Distribution. North America.

Biology. Lives and feeds on hydrae.

336 IV. Subfamily ALONINAE Frey, 1967

Frey, 1967a:36.

Type genus: Alona Baird, 1843.

Mandible articulated with integument between head shield and valves. Two or three main pores, situated in median line of head shield, small pores situated lateral to them. Subitaneous eggs two at a time, latent eggs one at a time. Claws with a single basal spine, sometimes without basal spine. Anus situated in proximal part of postabdomen. Hepatic processes absent. Length 0.3–1.3 mm. Canals extending from lateral head pores. The subfamily contains 14 genera with 100 species.

Legs 5–6 pairs. Leg VI, if present, without epipodite. Endite of leg II with 8 hook-shaped setae, without accompanying row of soft setae. One seta on exopodite of leg III much larger than the others. Exopodite of leg IV with 6 setae, exopodite of leg V with 4 setae.

All the preceding subfamilies show a characteristic structure of the head pores, but the subfamily Aloninae contains a variety of structure. The main head pores may be as follows: 1) 3, with a narrow connection between them; 2) 2, with a narrow connection between them; 3) 2, with a broad connection between them; 4) 2 separate pores with 2 small pores between them and 2 small pores laterally; 5) a single pore. In view of the great phylogenetic importance of the structure of the head pores, these differences permit a revision of the genus Alona. In fact, Alona has remained the least well defined genus of Chydoridae. This is inconvenient because Alona contains more species than any other genus of Chydoridae.

We leave in the genus Alona the species with 3 main head pores and establish another genus for the species with 2 main head pores with a narrow connection. The species with 2 broadly connected head pores were placed by Frey (1965a) in the genus Tretocephala. The genera of the subfamily Aloninae can then be classified as follows. Three main head pores: Alona s. str., Kurzia, Acroperus, Kozhowia, Camptocercus, Graptoleberis, Leydigia. Two main head pores with a narrow connection: Biapertura; two main head pores with a broad connection: Tretocephala, Leydigiopsis, Rhynchotalona. Two separate main head pores: Oxyurella. One main head pore: Euryalona, Indialona, Monospilus. These groups are further distinguished by the form of the body, legs, postabdomen, etc. Indialona has a single main head pore, but the systematic position of this genus is not clear because the description of the legs is incomplete.

Key to Genera of the Subfamily Aloninae

1 (28). Rostrum not elongate; if rostrum long and directed posteriorly, postabdomen with a few anal denticles; only 2 distal denticles large.
2 (15). Three main head pores.
3 (14). Lateral setae of postabdomen not very large. Exopodite of leg III with 7 setae.
4 (7). Postabdomens of varying form but not narrow or very long.
5 (6). Anterior margin of head shield not broadly rounded, not projecting anteriorly in lateral view .... 12. Alona Baird, 1843 (p. 337).
6 (5). Anterior margin of head shield broadly rounded, projecting anteriorly in lateral view. Valve with straight ventral margin ... . 17. Graptoleberis Sars, 1862 (p. 443).
7 (4). Postabdomen narrow and long.
8 (9). Postabdomen straight, with parallel dorsal and ventral margin .. .. 14. Acroperus Baird, 1843 (p. 400).
9 (8). Postabdomen tapering distally.
10 (11). Rostrum projecting. Leg III markedly different from leg IV ... . 13. **Kurzia** Dybowski and Grochowski, 1894 (p. 396).
11 (10). Rostrum not projecting. Leg III resembling leg IV.
12 (13). Postabdomen moderately long (ratio of length:width at most 4:3). Dorsal or head keel absent .... 15. Kozhowia G. L. Vasiljeva and N. N. Smirnov, 1969 (p. 420).
13 (12). Postabdomen very long. Keel present in most species .... 16. Camptocercus Baird, 1843 (p. 429).
14 (3). Lateral setae of postabdomen very large. Anal denticles very small .... 18. Leydigia Kurz, 1875 (p. 449).
15 (2). Two or one main head pores.
16 (23). Two main head pores.
17 (22). Main pores connected.
337 18 (19). Pores narrowly connected .... 19. Biapertura N. N. Smirnov gen. n. (p. 466).
19 (18). Pores broadly connected.

20 (21). Rostrum short, blunt. Anal denticles in the form of setae . . . . 20. **Tretocephala** Frey, 1965 (p. 480).
21 (20). Rostrum very long, curved posteriorly. Anal denticles not numerous; two distal denticles especially large . . . . 21. **Rhynchotalona** Norman, 1903 (p. 490).
22 (17). Main head pores separate . . . . 22. **Oxyurella** Dybowski and Grochowski, 1894 (p. 491).
23 (16). One main head pore.
24 (27). Eye and ocellus present.
25 (26). Body much longer than high . . . . 23. **Euryalona** Sars, 1901 (p. 497).
26 (25). Body only slightly longer than high . . . . 24. **Indialona** Petkovski, 1966 (p. 501).
27 (24). Only ocellus present . . . . 25. **Monospilus** Sars, 1862 (p. 506).
28 (1). Rostrum elongate, directed ventrally or posteriorly. Postabdomen rounded, wide, with numerous well developed anal denticles . . . . 26. **Leydigiopsis** Sars, 1901 (p. 509).

Key to Genera of the Subfamily Aloninae according to Head Shields

1 (22). Two or three main head pores.
2 (21). Main head pores connected.
3 (14). Three main head pores.
4 (11). Small pores at a moderate distance from the main pores.
5 (10). Head shield with blunt anterior margin.
6 (9). Anterior margin of head shield blunt but with slightly prolonged apex.
7 (8). Small pores situated some distance from the main pores . . . . 12. **Alona**.
8 (7). Small pores situated very close to the main pores . . . 18. **Leydigia**.
9 (6). Anterior margin of head shield uniformly broadly rounded . . . . 17. **Graptoleberis**.
10 (5). Anterior margin of head shield with pointed rostrum . . . 13. **Kurzia**.
11 (4). Small head pores situated far from the main pores (near margin of head shield).
12 (13). Distance from apex of rostrum to posterior end of fornix longer than distance from posterior end of fornix to posterior end of head shield . . . . 14. **Acroperus**.
13 (12). Distance from apex of rostrum to posterior end of fornix as long as distance from posterior end of fornix to posterior end of head shield . . . . 16. **Camptocercus**.
14 (3). Two main head pores.
15 (16). Pores narrowly connected . . . . 19. **Biapertura**.
16 (15). Pores broadly connected.
17 (18). Anterior margin of head shield broadly rounded . . . . 20. **Tretocephala**.
18 (17). Anterior margin of head shield produced into a long rostrum.
19 (20). Rostrum pointed . . . . 21. **Rhynchotalona**.
20 (19). Rostrum blunt . . . . 26. **Leydigiopsis**.
21 (2). Two separate main head pores. Small pores present between them and lateral to them . . . . 22. **Oxyurella**.

22 (1). One head pore.
23 (26). Anterior margin of head shield broadly rounded or truncate.
24 (25). Posterior margin of head shield broadly rounded, anterior margin truncate . . . . 23. Euryalona.
25 (24). Head shield with broadly rounded posterior and anterior margin; if posterior margin pointed, anterior margin truncate . . . . 24. Indialona.
26 (23). Anterior margin of head shield produced into a rostrum with blunt apex . . . . 25. Monospilus.

12. Genus Alona Baird, 1843, emend. N. N. Smirnov

O. F. Müller, 1785:72–78 (Lynceus, part); Linné, 1788 (Monoculus part); Baird, 1843:92 (subgenus Alona); 1850-131; P. E. Müller, 1867: 171–173 (Alona part). 184 (Phyrxura syn.n.); Kurz, 1875:47–50; Herrick, 1884:91–93 (section Alona vera); Dybowski and Grochowski, 1894:381 (Coronatella); Lilljeborg, 1900:446–448 (Lynceus part); Sars, 1901:48; Sars, 1916:331; Bergamin, 1940:49–50; Šrámek-Hušek et al., 1962:330; Herbst, 1962:84–86.

Type species: Alona quadrangularis (O. F. Müller, 1785) (Johnson, 1956a:202).

Baird stated in the original description (1843:92, as subgenus) that the valve is rectangular with lines and the antennae are short. Posterodorsal 338 corner situated slightly below the highest point of the dorsal margin. Rostrum blunt, short. Setae on antennae: 0–0–3/1–1–3. Main head pores situated on median line of head shield, and a small pore lateral to them (Frey, 1959, 1962a). Three main head pores connected to one another. Postabdomen with postanal denticles and lateral setae. Anus situated in proximal part of postabdomen.

Five to six pairs of legs. Leg I with rows of setae on anterior side of endite. Endite of leg II with 8 hook-shaped setae, without a row of soft setae. Exopodite of leg III with 7 setae; seta 6 very large. Exopodite of leg IV with 6 setae including 2 sparsely pubescent anterior setae. Exopodite of leg V very large, with 4 setae, a small seta on the anterior side and 3 on the posterior side. Leg VI, if present, in form of a small lobe without epipodite. Rostrum of male shorter than that of female. Vas deferens opening near and ventral to base of claws.

Many species the head pores of which have not been described were left in the genus Alona. Their systematic position may have to be changed after they have been described.

Key to Species of the Genus Alona according to Females

1 (86). Plate of labrum without denticles on anterior margin.
2 (85). Plate of labrum wide, not oblong.
3 (76). Postabdomen not widening distally.
4 (71). Postabdomen not elongate, dorsal and ventral margin not parallel.

5 (50). Postabdomen with rounded distal and dorsal margin.
6 (37). Postabdomen not narrowing distally.
7 (16). Postabdomen with long postanal part.
8 (13). Anal denticles large.
9 (10). Anal denticles narrow. Maximum height behind middle of body. Valves indistinctly reticulate . . . . 1. **A. quadrangularis** (O. F. Müller, 1785).
10 (9). Anal denticles wide.
11 (12). Anal denticles uniformly spaced. Anal denticles with smooth posterior side . . . . 2. **A. capensis** Rühe, 1921.
12 (11). Anal denticles in groups of two and three . . . . 3. **A. sarasinorum** Stingelin, 1900.
13 (8). Anal denticles small.
14 (15). Anal denticles about 8, accompanied by a small denticle . . . . 4. **A. poppei** Richard, 1897.
15 (14). Anal denticles isolated, 8 in number. . . 5. **A. harpularia** Sars, 1916.
16 (7). Postabdomen with short postanal part.
17 (34). Posterior margin of postabdomen not rounded and projecting.
18 (33). Proximal segment of endopodite of antenna without a large spine reaching to distal end of third segment.
19 (30). Posteroventral corner of valve without denticles or thick setae (however, there is a form with serrated posteroventral corner).
20 (29). Anal denticles present.
21 (28). Anal denticles gradually decreasing in size proximally.
22 (27). Anal denticles long.
23 (26). Spines on antennae: 1–0–1/0–0–1.
24 (25). Penultimate abdominal segment with a few setae . . . . 6. **A. rectangula** Sars, 1862.
25 (24). Penultimate abdominal segment with dense setae on dorsal side . . . . . . 7. **A. setosocaudata** G. L. Vasiljeva and N. N. Smirnov, 1969.
26 (23). Spines on antennae: 1–0–1/1–1–1 . . . 8. **A. macrocopa** Sars, 1895.
27 (22). Anal denticles short, small . . . . 9. **A. arcuata** Sars, 1916.
28 (21). 2–4 distal anal denticles markedly larger than the others . . . . 10. **A. crassicaudata** Sars, 1916.
29 (20). Anal teeth absent. Lateral setae present. Valve with numerous longitudinal lines . . . . 11. **A. striolata** Sars, 1916.
30 (19). Posteroventral corner of valve with denticles or with denticles and dense setae. Posterior seta in the lateral groups on the postabdomen is the longest, reaching to or extending beyond margin of postabdomen. Basal spine of claw $\frac{1}{3}$ to $\frac{1}{2}$ as long as claw.
31 (32). Posteroventral corner of valves with 1–3 denticles . . . . 12. **A. monacantha** Sars, 1901.
32 (31). Posteroventral corner of valves with thick setae and very small denticles . . . . 13. **A. circumfimbriata** Megard, 1967.
33 (18). Proximal segment of endopodite of antenna with a large spine extending almost to distal end of third segment . . . . 14. **A. holdeni** Green, 1952.
34 (17). Posterior margin of postabdomen rounded and projecting.
35 (36). Plate of labrum entire. Esthetascs projecting beyond apex of rostrum. Ocellus slightly smaller than eye . . . . 15. **A. rustica** Scott, 1895.

36 (35). Plate of labrum with an incision on anterior margin. Esthetascs not projecting beyond apex of rostrum. Ocellus larger than eye . . . . 16. A. **bicolor** Frey, 1965.
37 (6). Postabdomen narrowing distally.
38 (47). Anal denticles developed.
39 (46). Anal denticles at most 9.
40 (43). Lateral setae present.
41 (42). Valves punctate. Plate of labrum with 2 groups of setae on the apex . . . . 17. A. **virago** Brehm, 1935.
42 (41). Valves striated. Plate of labrum without setae . . . . 18. A. **bukobensis** Weltner, 1896.
43 (40). Lateral groups of setae absent.
44 (45). Anal denticles large. Claws with a short basal spine . . . . 19. A. **weltneri** Keilhack, 1905.
45 (44). Anal denticles small. Basal spine reaching to half the length of the claw . . . . 20. A. **cannellata** Brehm, 1934.
46 (39). Anal denticles more than 9 21. A. **davidi** Richard, 1895.
47 (38). Anal denticles little developed.
48 (49). Lateral setae short, small . . . . 22. A. **inermis** Pesta, 1928.
49 (48). Lateral setae large, isolated, projecting beyond dorsal margin of postabdomen . . . . 23. A. **milleri** Kiser, 1948.
50 (5). Postabdomen with truncate distal margin.
51 (70). Lateral setae in groups, or in 2 rows if isolated.
52 (69). Posteroventral corner of valve without denticles.
53 (68). Anal denticles long.
54 (63). Anal denticles usually 10 or more.
55 (56). Small head pores transverse. Anal denticles gradually decreasing in size proximally . . . . 24. A. **costata** Sars, 1862.
56 (55). Small head pores rounded.
57 (60). Postabdomen with parallel margins. Valves without pattern of polygons or lines. Posterior seta in the lateral groups on the postabdomen is the longest, reaching or extending beyond margin of postabdomen. Basal spine about $^1/_4$ length of claw.
58 (59). Posterior seta in the lateral groups of setae thin. Main head pores completely connected . . . . 25. A. **pulchella** King, 1853.
59 (58). Distal seta in lateral groups of setae large and spine-shaped. Connection between main head pores interrupted . . . . 26. A. **setulosa** Megard, 1967.
60 (57). Postabdomen narrowing distally.
61 (62). Distal anal denticles slightly larger than the others. Valve with polygons with dots in them . . . . 27. A. **cambouei** Guerne and Richard, 1893.
62 (61). Distal anal denticles larger than the others . . . . 28. A. **inreticulata** Shen Chia-jui et al., 1964.
63 (54). Anal denticles usually less than 10.
64 (65). Anal denticles thin. Plate of labrum with slightly pointed apex . . . . 29. A. **fasciculata** Daday, 1905.
65 (64). Anal denticles wide. Plate of labrum with rounded apex. Lateral groups of thin setae which do not reach margin of postabdomen. The groups consist of almost equally long setae, or the middle seta is the longest.

66 (67). Postabdomen with pointed distal angle (about 60°). Head shield with rounded posterior margin .... 30. A. **guttata** Sars, 1862.
67 (66). Distal angle of postabdomen about 90°, often slightly rounded. Posterior margin of head shield forming a pointed angle .... 31. A. **barbulata** Megard, 1967.
68 (53). Anal denticles short. Lateral setae absent .... 32. A. **clathrata** Sars, 1888.
69 (52.) Posteroventral corner of valve with denticles .... 33. A. **protzi** Hartwig, 1900.
70 (51). Lateral setae isolated, in one row .... 34. A. **archeroides** Brehm, 1933.
71 (4). Postabdomen elongate, with parallel dorsal and ventral margin.
72 (75). Lateral setae in groups.
73 (74). Dorsal distal corner of postabdomen projecting distinctly beyond base of claws .... 35. A. **karelica** Stenroos, 1897.
74 (73). Dorsal distal corner of postabdomen not projecting beyond base of claws .... 36. A. **subantarctica** Eckman, 1908.
75 (72). Lateral setae isolated, long .... 37. A. **archeri** Sars, 1889.
76 (3). Postabdomen widening distally.
77 (84). Maximal width of postabdomen at base of claws.
78 (79). Anal denticles short .... 38. A. **eximia** Kiser, 1948.
79 (78). Anal denticles long.
340 80 (83). Anal denticles uniformly spaced, not thin.
81 (82). Anal denticles gradually increasing in size distally .... 39. A. **pseudanodonta** Brehm, 1933.
82 (81). Distal anal spinules much larger than the others .... 40. A. **microtata** Henry, 1922.
83 (80). Anal spinules thin, irregularly spaced .... 41. A. **inkiti** Schiklejew, 1929.
84 (77). Maximum width of postabdomen some distance from base of claws; postabdomen with broadly convex dorsal margin .... 42. A. **parva** (Daday, 1905).
85 (2). Plate of labrum elongate, wedge-shaped .... 43. A. **labrosa** G. L. Vasiljeva and N. N. Smirnov, 1969.
86 (1). Plate of labrum with a denticle on anterior margin.
87 (88). Valve without tubercles. Incision between base of claws and dorsal distal end of postabdomen absent .... 44. A. **abbreviata** Sars, 1896.
88 (87). Valve with tubercles in ventral part. Incision between base of claws and dorsal distal end of postabdomen present .... 45. A. **hardingi** Brehm, 1957.

Key to Known (Adequately Described) Males of the Genus Alona

1 (20). Dorsal and ventral margin of postabdomen not parallel.
2 (3). Dorsal margin of postabdomen strongly convex, curved .... 1. A. **quadrangularis**.
3 (2). Dorsal margin of postabdomen slightly convex, straight or concave.

4 (7). Dorsal margin of postabdomen slightly convex.
5 (6). Claw with a basal spine. Lateral setae weakly developed . . . . 12. A. monacantha.
6 (5). Claw without basal spine . . . . 32. A. clathrata.
7 (4). Dorsal margin of postabdomen straight or concave. Postabdomen slightly tapering distally.
8 (13). Dorsal margin of postabdomen straight.
9 (10). Anal denticles present . . . . 19. A. weltneri.
10 (9). Anal denticles absent.
11 (12). Lateral setae in groups . . . . 21. A. davidi.
12 (11). Lateral setae isolated . . . . 37. A. archeri.
13 (8). Dorsal margin of postabdomen slightly concave. Postabdomen strongly narrowing distally.
14 (15). Claw with a basal spine. Dorsal margin of postabdomen with a rounded apex posteriorly . . . . 15. A. rustica.
15 (14). Claw without basal spine. Dorsal margin of postabdomen reaching base of claws without forming an apex.
16 (17). Well developed row of groups of lateral setae present . . . . 24. A. costata.
17 (16). Setae of postabdomen little developed or absent.
18 (19). Setae of postabdomen little developed . . . . 30. A. guttata.
19 (18). Setae of postabdomen absent . . . . 8. A. macrocopa.
20 (1). Dorsal and ventral margin of postabdomen parallel.
21 (22). Postabdomen short . . . . 6. A. rectangula.
7. A. setosocaudata, 13. A. circumfimbriata, 26. A. setulosa, 28. A. inreticulata.
22 (21). Postabdomen long . . . . 35. A. karelica.

1. Alona quadrangularis (O. F. Müller, 1785)
(Figures 382–386)

O. F. Müller, 1785:72–73, Plate IX, Figures 1–3 (Lynceus); Linné, 1788, 3008 (Monoculus); Fabricius, 1793:498 (Monoculus); Baird, 1850:131–132, Plate XVI, Figure 4; Schoedler, 1858:28 (fulcata); 1862: 21–24, Plate 1, Figures 24, 25 (sulcata); 1863:21, Plate 1, Figures 24, 25 (sulcata); P. E. Müller, 1867:176, Plate III, Figures 20, 21; 177–178 (sanguinea); Birge, 1892:393–394, Plate XIII, Figure 19 (lepida); Lilljeborg, 1900:448–454, Plate LXVI, Figures 8–17 (Lynceus); Stingelin, 1906:324–325, Plate 13, Figure 19; Vereshchagin, 1911b:555 (mph. (dilatata); 1912a:127–128, Plate III, Figure 51 (var. dilatata); Bening, 1941:309–312, Figure 128; Motas and Orghidan, 1948:126–127, Figure 4 (macrops, non Daday); Frey, 1959:36, Figures 34, 35; 1962a, Figures 34, 35; Šrámek-Hušek et al., 1962:343–344, Figure 127; Herbst, 1962:89, Figure 68; Sebestyén, 1965:196–197, Plate 3; Smirnov, 1966a, Figure 19; Negrea, 1966a:142–143.

Material. Numerous females from the Ladka River (tributary of the Rybinsk Reservoir), Pechora River, Lake Biili-Kul' (Dzhambul Region), and the Amur basin; several females from ponds of the Yakot' fish farm; 2 females from a brook near Rotorua, New Zealand. Several males from the Rybinsk Reservoir. Preparations: MGU – female 400, malformed female 18. ZIN – female 53872 (401). Ph – female 930.

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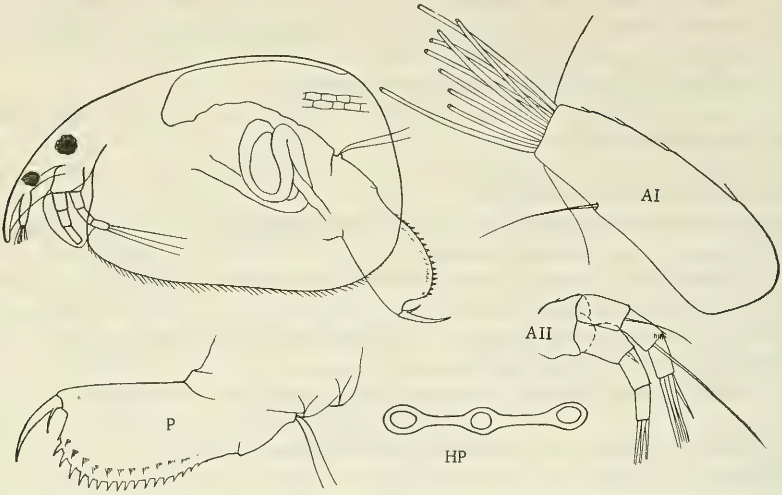

FIGURE 382. Alona quadrangularis, female, length 0.53 mm (Ladka River, 14 August 1962, preparation 400):

P – preparation 401.

Female. Maximum height near posterior end of body. Valves with rounded posterodorsal and posteroventral corner. Posterior margin of valves with spinules on the inner side. Valve with longitudinal lines connected by transverse lines, forming cells without longitudinal striation. Head shield with 3 connected main pores; lateral pores at level of median main pore. Head shield with pointed posterior margin.

Antennules distally with a sensory seta and a sensory papilla on the posterior margin; anterior margin with incisions. Setae on antennae: 0–0–3/1–1–3. Seta on proximal segment of endopodite of antenna little longer than endopodite. Plate of labrum with convex anterior margin.

Postabdomen widening distally. Distally, on the dorsal margin of the postabdomen, extend 2 rows of 16–18 anal denticles, 2–3 proximal and 2 distal denticles smaller. Laterally, there is a row of groups of setae which extend to middle of anus. Claws with or without a row of small setae. Intestine with 1–5 loops and with a caecum. Ocellus smaller than eye. Legs typical for the genus. Leg I with isolated thick setae on the anterior side. Outer branch of endite of leg I with 2 long setae and a hook-shaped seta which is less than half as long. Length to 0.7 mm.

Male. Posteroventral corner of valve rounded, without denticles. Antennules not reaching apex of rostrum. Anterior margin of antennule distally with a 2-segmented flagellum; posterior margin distally with a sensory papilla, proximally with a sensory seta. Postabdomen without anal denticles but with a lateral row of groups of setae. Preanal corner distinct. Claws with a basal spine. Vas deferens opening ventrally at base of claws. Intestine with 1.5 loops, with a caecum. Length to 0.6 mm.

(342)

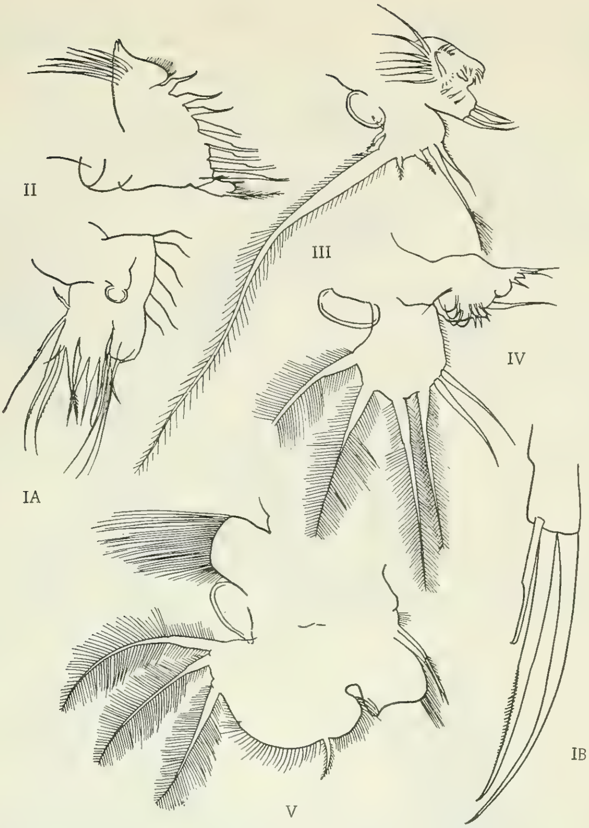

FIGURE 383. Legs of female of Alona quadrangularis (Ladka River, 14 August 1962):

IA — right leg, outer side; IB — outer part of endite of right leg I, inner side; II — left leg, outer side; III, IV, V — left legs, inner side.

Vereshchagin (1911a) gave the name Alona quadrangularis mph. dilatata to a form described by Lilljeborg (1900:451, Plate XVI, Figure 10).

Distribution. Holarctic, Ethiopian, Indo-Malayan, Neotropical regions. Ubiquitous in the USSR (no collections have been made in Siberia).

Biology. Lives in silt. Monocyclic, regardless of length of vegetation season.

2. Alona capensis Ruhe, 1921 (Figure 387)

Rühe, 1921:19–20, Figure 5a, b.

Material. According to description.

342 Female. Valves with rounded posterodorsal and posteroventral corner. Valves with pattern of polygons in the posterior part. Antennules

(343)

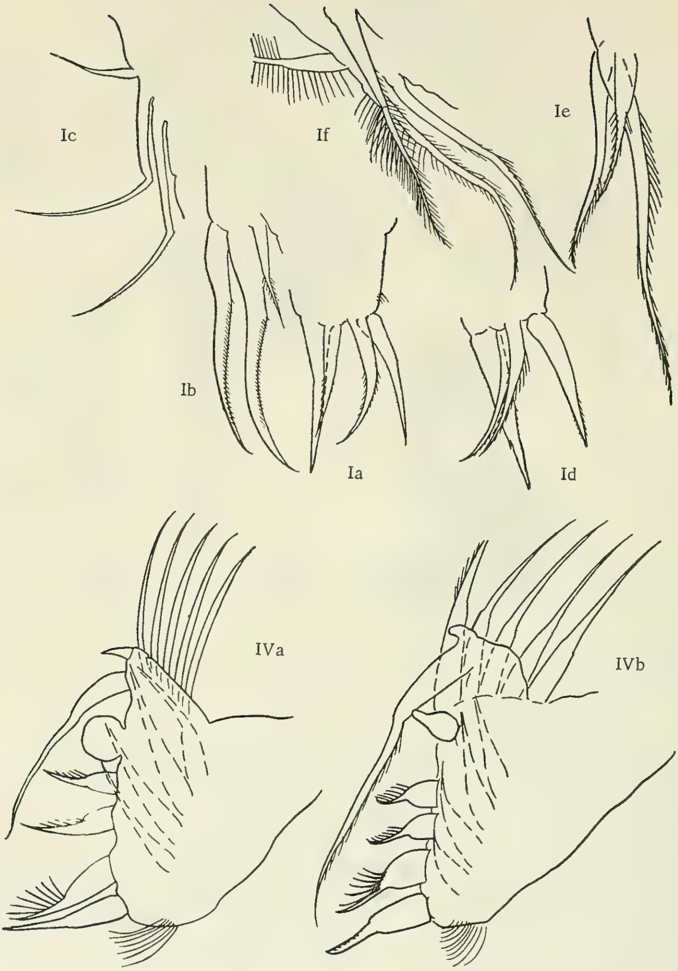

FIGURE 384. Parts of legs I (right) and IV (left):

Ia, Ib, Ic, IVa — Alona quadrangularis (Ladka River, tributary of Rybinsk Reservoir, 8 August 1962); Id, Ie, If, IVb — Biapertura affinis ornata (Vel'yu River, tributary of the Pechora, 2 August 1958); Ia, Id — anterior part of inner branch of endite; Ib, Ie — posterior part of inner branch of endite; Ic, If — setae on posterior side of endite; IVa, IVb — endite and gnathobase.

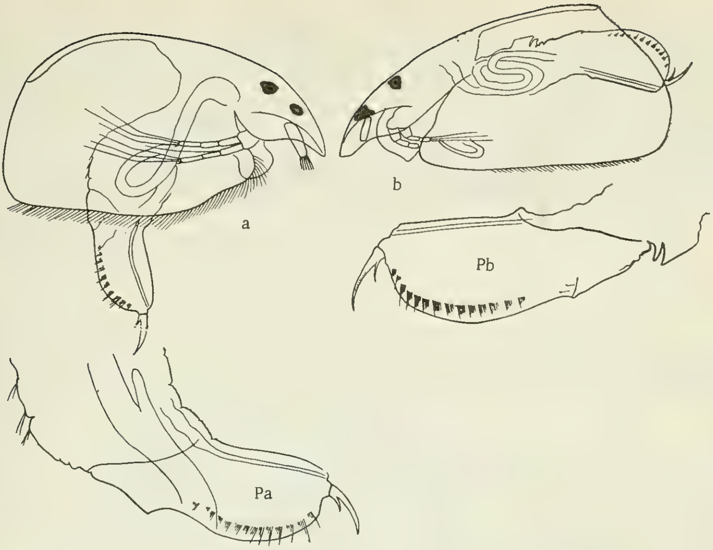

FIGURE 385. Alona quadrangularis, male:

a, Pa — after Lilljeborg, 1900; b, Pb — Rybinsk Reservoir, Borok, 14 July 1964, preparation 60; b — length 0.56 mm.

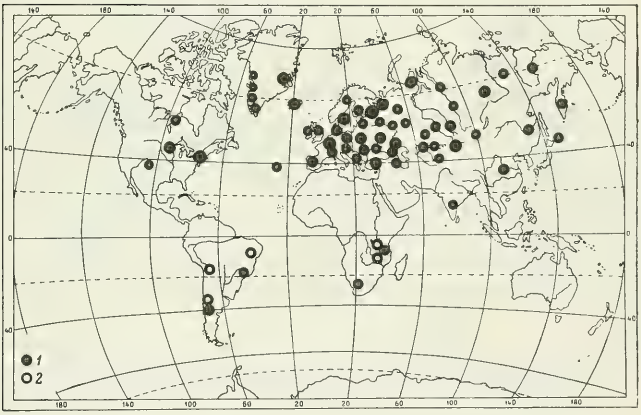

FIGURE 386. Distribution:

1 — Alona quadrangularis; 2 — A. poppei.

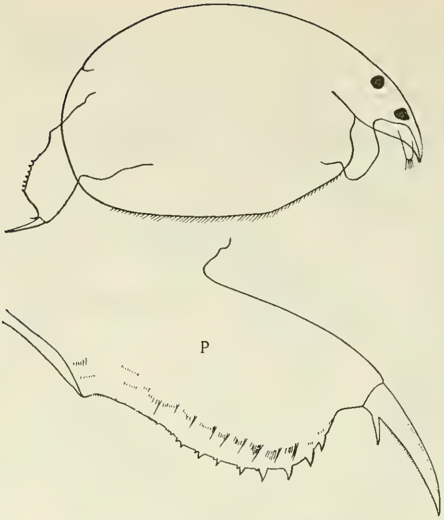

FIGURE 387. Alona capensis, female (after Rühe, 1921)

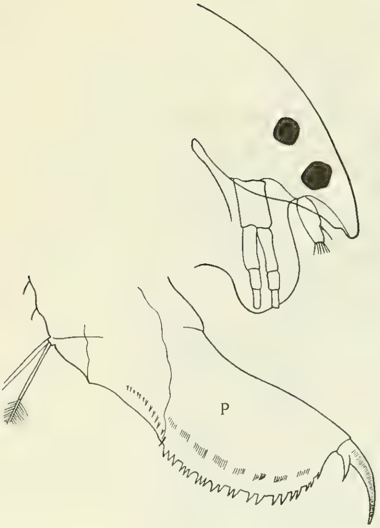

FIGURE 388. Alona sarasinorum, female (after Stingelin, 1900)

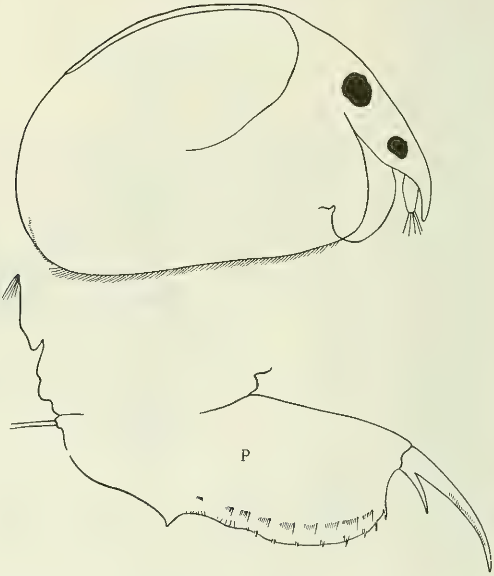

FIGURE 389. Alona poppei, female (after Richard, 1897b)

not quite reaching apex of rostrum; esthetascs projecting beyond apex of rostrum. Postabdomen with 7 large anal denticles which decrease in size proximally; further on about 5 groups of denticles. Proximal large denticles accompanied by a small denticle. About 11 groups of setae laterally. Claw with setae on the concave side and at the convex margin.

According to Brehm (1933b), there are 8 anal denticles and 9 lateral groups of setae. Ocellus slightly smaller than eye. Length to 0.62 mm.

Male. Unknown.

Distribution. South Africa.

3. **Alona sarasinorum** Stingelin, 1900 (Figure 388)

Stingelin, 1900:197–198, Plate 14, Figures 4, 5; Brehm, 1933b:78–79, Figure 1.

Material. According to description.

343 Female. Valve with hairs on inner side of posterior margin. Valve without sculpture, sometimes punctate. Rostrum blunt. Antennules reaching apex of rostrum. Plate of labrum rounded. Preanal corner slightly projecting. Postabdomen with irregularly distributed anal denticles, distally in pairs, proximally in groups of three. Eight groups of setae laterally. Claws with a basal spine and with setae laterally. Ocellus larger than eye. Length to 0.52 mm.

Male. Unknown.

346 Distribution. Indo-Malayan Region.

4. **Alona poppei** Richard, 1897 (Figures 386, 389)

Richard, 1897b:290–292, Figures 37–38; Delachaux, 1917:85–86, Figures 11–12; 1919:29, Plate II, Figures 4, 5.

Material. According to description.

Female. Posterodorsal and posteroventral corners of valve rounded. Valve with lines. Ventral margin of valve with setae passing into a row of hairs which continues on the posterior margin. Antennules almost reaching apex of rostrum. Postabdomen with projecting preanal corner. Anal margin slightly concave, with spinules. Lateral setae in 9 groups; distal setae of groups larger than the others and not reaching dorsal margin of postabdomen. Anal denticles about 8, accompanied by a small denticle. Claws with setae on the concave margin and with a basal spine. Length 0.63 mm.

Male. Unknown.

Distribution. Ethiopian and Neotropical regions.

5. **Alona harpularia** Sars, 1916 (Figure 390)

Sars, 1916:332–333, Plate XXXIX, Figures 2, 2a.

Material. According to description.

Female. Valves with distinct posterodorsal corner. Posteroventral corner rounded, without denticles. Valves with 12–15 longitudinal lines

(347)

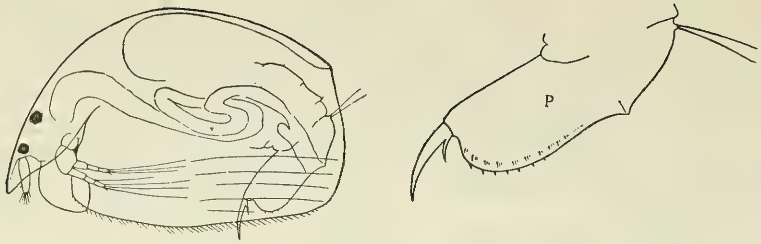

FIGURE 390. Alona harpularia, female (after Sars, 1916)

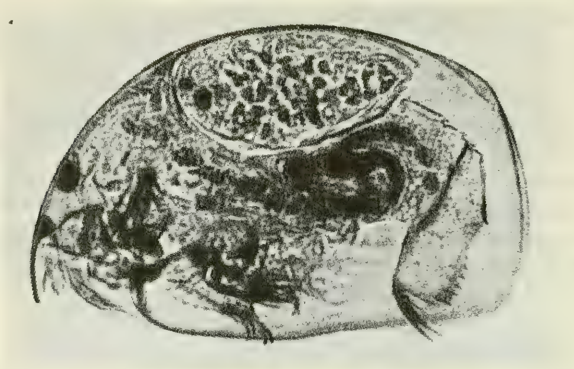

Figure 391. Alona rectangula rectangula, female: Photograph by Frey, after type of Sars.

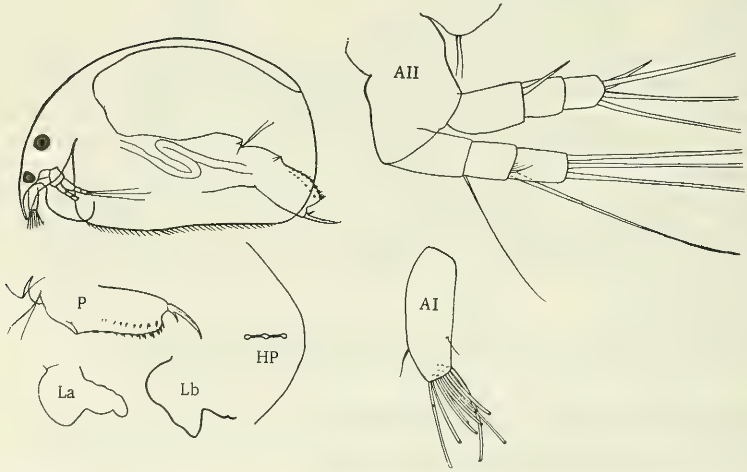

FIGURE 392. Alona rectangula rectangula, female, length 0.34 mm:

HP — head pores of A. rectangula (after Frey, 1962a); AII — left antenna, outer side; AI — left antennule, outer side; P, La, AI, AII — Il'd River, Yaroslav Region, 10 August 1962; Lb — Lem'yu River, Komi ASSR, 22 August 1962, preparation 1799.

(Brehm, 1933b). Antennules reaching apex of rostrum. Postabdomen with distinct preanal corner. About 8 small anal denticles. About 12 lateral groups of setae. Claws with a basal spine. Ocellus situated halfway between eye and apex of rostrum. Length to 0.55 mm.

Male. Unknown.

Distribution. South Africa.

6. Alona rectangula Sars, 1862

The following names cannot be placed in a definite subspecies: Fischer, 1854:429–430, Figures 15, 16 (Lynceus lineatus); Daday, 1888:97, Plate II, Figures 1,2 (stagnalis syn. n.); Dybowski and Grochowski, 1894:381 (Coronatella); Lilljeborg, 1900:476–482, Plate LXVIII, Figures 30, 31, Plate LXIX, Figures 4, 5, 6 (Lynceus rectangulus); Brehm, 1908b:8–9, Figure (L. rectangulus var. leydigioides); Frey, 1959:36, Figures 26, 27; 1962a, Figures 26, 27; Negrea, 1966a:142.

Female. Valves with rounded posterodorsal and posteroventral corners. Valves sometimes with longitudinal lines or with rows of tubercles. Head shield with 3 connected main pores (Frey, 1959, 1962a). Head shield with rounded posterior margin. Setae on antennae: 0–0–3/1–1–3; spines present on proximal segment of exopodite, on second segment of endopodite and on both distal segments. Plate of labrum with convex ventral margin. Postabdomen wide, with rounded dorsal distal margin. Anal margin slightly concave, with a lateral row of setae. Seven to 9 anal denticles, sometimes in groups. The distal denticle of the group is the largest. Lateral surface of claws with several lines in the middle and with 2 groups of hairs nearer to the base. Claws with a row of setae in proximal $^3/_4$ of the concave margin (Frey, 1958). Ocellus almost as large as eye. Legs typical for the genus. Length 0.5 mm.

Male. Valves with rounded posteroventral corner. Antennules ending slightly before apex of rostrum, their anterior margin distally with a 2-segmented flagellum and a sensory seta. Postabdomen wide, slightly tapering distally. Vas deferens opening ventrally some distance from the claws. Length to 0.3 mm.

Distribution. Cosmopolitan. However, the forms placed in this species differ distinctly. According to Frey, it has not been found in North America.

Biology. Lives in vegetation. Survives under ice. Tolerates a salinity of up to 13.8‰ (Aral Sea; Bening, 1941).

Key to Subspecies of A. rectangula according to Females

1 (12). Posteroventral corner of valve without denticles.
2 (11). Valve without pits.
3 (10). Lateral setae in groups or absent.
4 (7). Ratio between distance from preanal corner to base of claws and maximum width of postabdomen 1.7 or less.

348 5 (6). Above ratio about 1.66. Five lateral groups of setae . . . .
. . . . 6a. A. rectangula rectangula Sars, 1862.
6 (5). Above ratio about 1.2–1.5. Lateral setae in 8 well developed
groups . . . . 6b. A. rectangula coronata Kurz, 1875.
7 (4). Ratio between distance from preanal corner to base of claws and
maximum width of postabdomen more than 1.7.
8 (9). Anal denticles in 6–8 groups . . . .
. . . . 6c. A. rectangula richardi Stingelin, 1895.
9 (8). Anal denticles separated, 8–10 . . . .
. . . . 6d. A. rectangula elegans Kurz, 1875.
10 (3). Lateral setae isolated . . . .
. . . . 6e. A. rectangula novae-zealandiae (Sars, 1904).
11 (2). Valve with pits . . . . 6f. A. rectangula pulchra Hellich, 1874.
12 (1). Posteroventral corner of valve serrated . . . .
. . . . 6g. A. rectangula serrata Daday, 1908.

6a. Alona rectangula rectangula Sars, 1862
(Figures 391–395)

Sars, 1862a:160 (rectangula); P. E. Müller, 1867:178, Plate IV, Figures 3, 4 (lineata), 181, Plate IV, Figures 8, 9 (guttata); P. E. Müller, 1868–1869:355 (intermedia); Hudendorff, 1876:53, Plate II, Figure 5 (inornata); Hellich, 1877:93–94 (lineata part); Matile, 1890:148 (coronata, tuberculata); 149, Plate IV, Figure 36 (pulchra); Szilády, 1900:6 (intermedia); Weigold, 1911:20 (angulata part); 21; Vereshchagin, 1911a:12–14, Figures 2, 3 (aculeata); 1913b:178, Figures 10, 11, 177, Figure 9 (intermedia); 1916:17–18, Figure 11 (rectangula var. rectangula); Bening, 1941:306, 307, Figure 126a (rectangula pulchra); Herbst, 1962:88–89, Figure 67 (rectangula); Šrámek-Hušek et al., 1962:346–347; Manuilova, 1964:251, Figure 134, 5; Smirnov, 1968b:9 (rectangula pseudopulchra – the name was proposed to distinguish between forms with a smooth and with a pitted valve, both described with the same name by Hellich).

Material. Several females from the following localities: Ivan'kovo, Rybinsk and Kama reservoirs, Komi ASSR, Myasnikovskii pond in the Perm Region, lakes in the Aktyubinsk and Dzhambul regions, Frolikh inlet of Lake Baikal, Lake Issyk-Kul', a puddle near Bol'shie Koty, Lake Baikal, near the rivers Utulik and Murina, a pond at Gayndah in Queensland, Australia; one female from a pond near Omsk and a small floodplain lake in the Amur basin, one female from the White Nile, several males from Shchugor River in the Komi ASSR, one male from Lake Kadil'noe, one male from Lake Baikal near the rivers Utulik and Murina. Preparations: MGU – female 1459, female with undulate plate of labrum 1799, male 1463, juvenile male 1458. ZIN – female 53875 (1454), 53876 (1089), male 53874 (1467).

Female. Valves without pits. Posteroventral corner of valve rounded, without denticles.

In the neotype, the ratio between the distance from the preanal corner to the base of the claws and the maximum width of the postabdomen is 1:66. Postabdomen with 7 anal denticles accompanied by setae. Anal margin
349 with 2 groups of setae. Five lateral groups of setae, the setae of 2 distal

groups projecting from beyond the margin of the postabdomen. Claws with a basal spine which is 1.5 times longer than basal width of claw. Concave margin of claw with setae on $^3/_4$ of its length. Ocellus slightly smaller than eye.

(348)

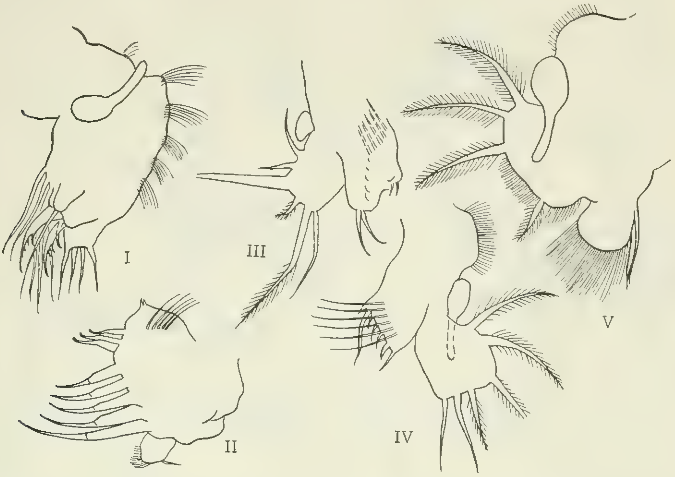

FIGURE 393. Legs of female of Alona rectangula rectangula (Il'd River, 10 August 1962):

I, III, V – left legs, outer side; II – left leg, inner side; IV – right leg, inner side.

Setae on antennae: 0–0–3/0–1–3, spines 1–0–1/0–0–1. Outer branch of endite of leg I with 3 setae, proximal setule of seta 3 forming a hook, 2 proximal setules of seta 2 forming hooks. Length 0.34 mm.

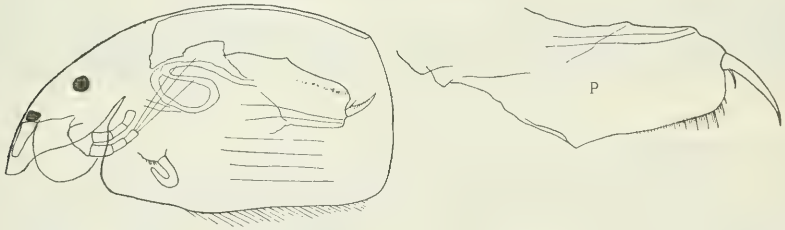

FIGURE 394. Alona rectangula rectangula, male, length 0.3 mm (Shchugor River, Kur'ya, Komi ASSR, 24 August 1958, preparation 1463):

P – postabdomen of another specimen with dorsally situated opening of vas deferens, preparation 1458.

Male. Valves with rounded posterodorsal and posteroventral corner. Valves with longitudinal lines. Antennules not reaching apex of rostrum. Plate of labrum broadly rounded. Postabdomen wide, short. Preanal corner distinct. Claws with a basal denticle. In the male examined (preparation 1463), anal denticles in the form of groups of setae. Vas deferens opening on ventral side of postabdomen some distance from base of claws. Outer branch of endite of leg I with 3 setae of about equal length. Ocellus situated halfway between eye and apex of rostrum. Length 0.3 mm.

(350)

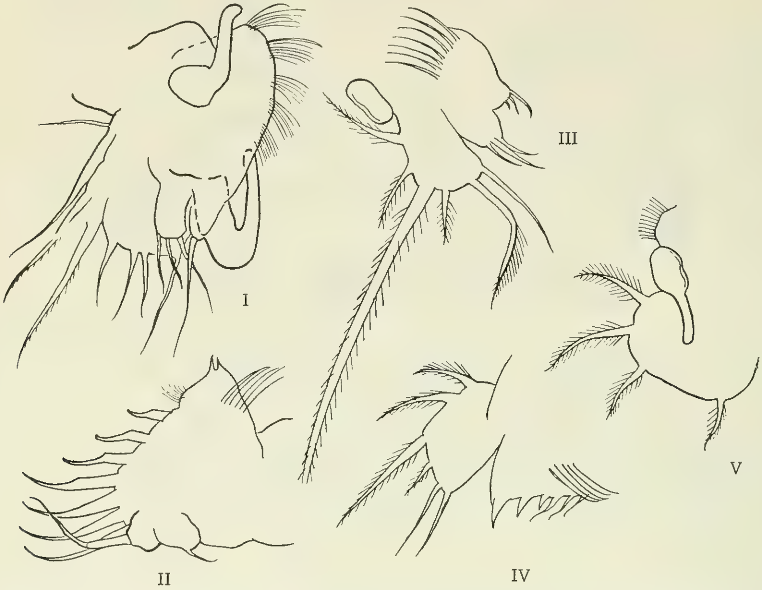

FIGURE 395. Legs of male of Alona rectangula rectangula (Pechora River above Shchugory, 8 August 1962). Right legs, outer view.

Bening (1941:305–306) does not use the structure of the valves for definition of this subspecies.

Distribution. Africa. USSR: Rybinsk Reservoir, Shchugor River in the Komi ASSR, Lake Issyk-Kul', Don River, Crimea, Pamir, Yamal.

6b. Alona rectangula coronata Kurz, 1875 (Figure 396)

Kurz, 1875:54–55, Plate II, Figures 4–6 (coronata); Shikleev, 1933:81, Figures 16–19 (var. caucasica); Bening, 1941:307, Figure 126c (caucasica); Šrámek-Hušek et al., 1962:347, Figure 128, A–E (var. caucasica); Manuilova, 1964:252 (caucasica).

Female. Valves with at most 20 longitudinal lines. Posteroventral corner of valves rounded, without denticles. Antennules not reaching apex of rostrum. Groups of anal denticles with 4–5 denticles and setae. Lateral groups 8, consisting of 4–5 setae, one of the groups large. Claws with a basal spine and with setae on the inner margin. According to A. L. Bening (1941), the ratio between distance from proximal corner of anus to base of claws and maximum width is 1.2–1.5. Ocellus situated halfway between eye and apex of rostrum. Length to 0.42 mm.

(350)

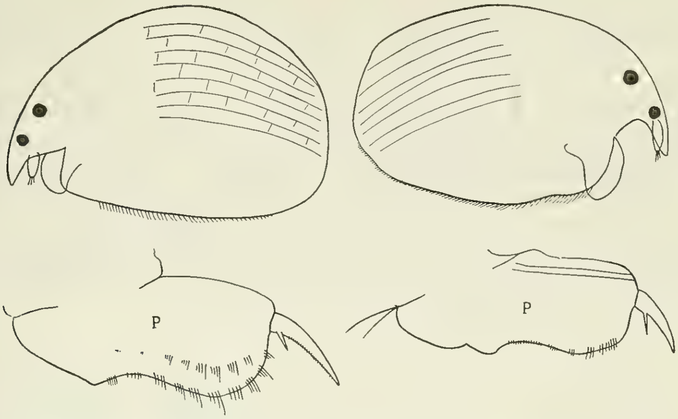

FIGURE 396. Alona rectangula coronata, female and male (after Shikleev, 1933)

Male. Valve with longitudinal lines. Antennules not reaching apex of rostrum. Ocellus as large as eye. Labrum rounded. Postabdomen with 5–6 lateral groups of 3–4 setae. Anal margin with hairs. Claws with a basal denticle $^2/_3$ as long as the claw.

Distribution. Danube delta, Caucasus.

6c. **Alona rectangula richardi** Stingelin, 1895

(Figures 397, 398)

Stingelin, 1895:250, Plate VII, Figure 37 (richardi); 248–249, Plate VII, Figures 34–35 (intermedia syn.n.); Sars, 1895:17–20, Plate III, Figures 7–10 (eucostata); Weigold, 1911:22 (richardi richardi); Bening, 1941:307, Figure 126c (richardi); Šrámek-Hušek et al., 1962:347, Figure 128F (var. richardi); Manuilova, 1964:252.

Material. One female from a pond on the Kalgan-Chirchik fish farm south of Tashkent. Preparation: MGU – female 2157.

Female. Posteroventral corner of valves rounded, without denticles. Valves with 20 longitudinal lines (Sars, 1895). Antennules almost reaching apex of rostrum. Antennules with a sensory seta in distal part of anterior margin and with distal sensory papillae. Plate of labrum rounded.

352 In the females examined there are 12 longitudinal lines at the posterior margin of the valve. Three main head pores. Outer branch of endite with large setae of slightly different length; setae distally with setules on one side, proximal setule large, chitinized and directed in the curvature of the base of the seta, so that it forms a hook together with the seta. Distal part of these setae with small, weakly chitinized setules.

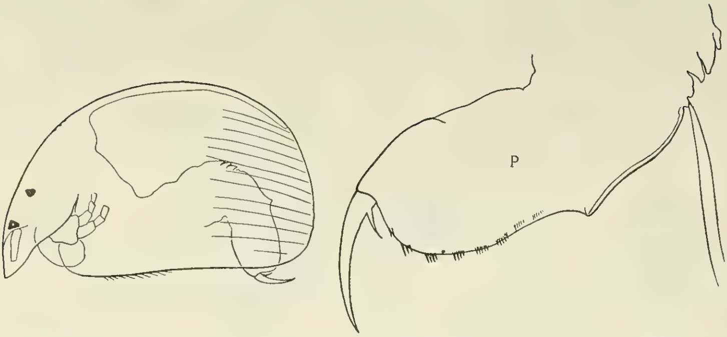

FIGURE 397. Alona rectangula richardi, female, length 0.39 mm (Kalgan-Chirchik fish farm, November 1961—February 1962, preparation 2157)

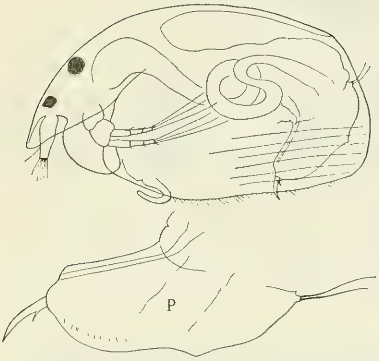

FIGURE 398. Alona rectangula richardi, male (after Sars, 1895)

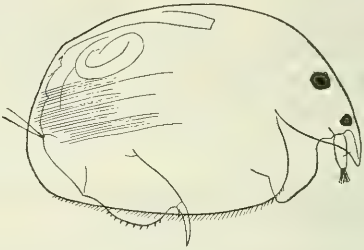

FIGURE 399. Alona rectangula elegans, female (after Kurz, 1875)

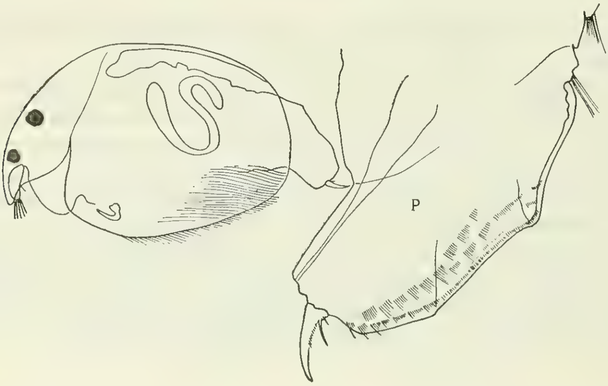

FIGURE 400. Alona rectangula elegans, male (after Herbst, 1964)

Postabdomen slightly widening distally. Preanal corner distinct. Ratio between distance from proximal corner of anus to base of claws and maximum width more than 1:8–1:9 (Bening, 1941). Dorsal distal margin of postabdomen with about 8 groups of lateral setae, 2–3 denticles and setae in each group. Lateral groups of setae absent or weakly developed. Claws with a basal spine. Ocellus slightly smaller than eye. Length 0.48 mm.

Male. According to Sars (1895), posteroventral corner of valve rounded, without denticles. Antennules projecting beyond apex of rostrum. Plate of labrum rounded. Postabdomen slightly tapering distally. Postabdomen with distinct preanal corner and with small lateral setae. Vas deferens opening near base of claws, ventral to it. Ocellus situated in middle between eye and apex of rostrum. Length 0.38 mm.

Distribution. New Zealand. USSR: Caucasus, Don River, Tashkent area.

6d. Alona rectangula elegans Kurz, 1875 (Figures 399, 400)

Kurz, 1875:51–52, Plate II, Figure 1 (elegans); Sars, 1903a:183–184, Plate VIII, Figures 3, 3a (elegans); Bening, 1941:308, Figure 126d; Šrámek-Hušek et al., 1962:347 (var. elegans); Herbst, 1964:40–48, Figures 1–12 (elegans arcuata); Manuilova, 1964:251, Figure 134, 3, 4.

Female. Valve with thin, dense longitudinal lines. Posteroventral corner of valves rounded, without denticles. Antennules reaching to apex of rostrum. Ratio between distance from proximal corner of anus to base of claws and maximum width more than 1.8–1.9. Dorsal distal margin of postabdomen with 2 rows of 8–10 separated anal denticles. Lateral groups of setae absent or weakly developed. Ocellus situated halfway between eye and apex of rostrum. Length to 0.5 mm.

Herbst (1964:40–48, Figures 1–12) also described A. elegans arcuata which is A. rectangula elegans arcuata Herbst, 1964 in our definition of the subspecies. This form is distinguished by its great relative height. Setae on antennae: 0–0–3/1–1–3, spines 1–0–1/0–0–1.

Male. Length (A. r. elegans arcuata, after Herbst) 0.4 mm.

Distribution. Central Europe. Eastern Balkhash area.

6e. Alona rectangula novae-zealandiae (Sars, 1904) (Figures 401, 402, 403)

Sars, 1904b:634–635, Plate XXXV, Figures 7, 7a, 7b (novae-zealandiae).

Material. Several tens of females from Browne Lake, Mt. Gambier, South Australia; one male from the same locality. Preparations: MGU – female 1575, ephippium 1547, male 1550. ZIN – female 53873 (1577). British Museum 68. 25 April 1939. 20 Jenkin 1934 K 157 NYC.

Female. Valves with rounded posterodorsal and posteroventral corner. Valves with 15–18 longitudinal lines (Brehm, 1933b). Antennules not reaching apex of rostrum. Postabdomen with distinct preanal corner. Anal denticles 9–12. Lateral setae present. Claws with a basal spine. Ocellus as large as eye, situated slightly nearer to eye than to apex of rostrum. Seta 3 of outer branch of endite of leg I with proximal setule forming a hook; seta 2 without hook-shaped setules (Figure 403). Length to 0.39 mm.

(353)

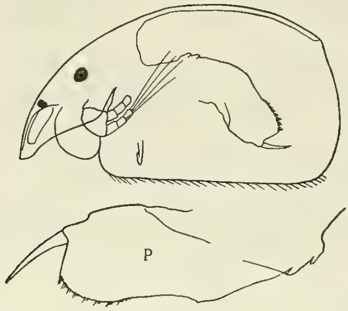

FIGURE 401. Alona rectangula novae-zealandiae, male, length 0.3 mm (Browne Lake, South Australia, 26 March 1964, preparation 1550)

Male. Valves with rounded posterodorsal and posteroventral corner. Antennules not reaching apex of rostrum. Plate of labrum broadly rounded. Postabdomen wide, short. Preanal corner indistinct. Anal denticles small, in groups. Claws without basal spine. Ocellus situated halfway between eye and apex of rostrum. Length 0.3 mm.

Distribution. Australia, New Zealand, Equatorial Africa.

6f. Alona rectangula pulchra Hellich, 1874 (Figure 404)

Hellich, 1874:219 (pulchra); 1877, Figure 51 (lineata part); Stingelin, 1895:249–250, Plate VII, Figure 36 (pulchra); Lilljeborg, 1900: 479, Plate LXIX, Figure 1 (Lynceus rectangulus var. pulchra); Johnson, 1956a:201 (pulchra nomen dubium); Frey, 1958:247, Plate 39, Figure 72 (var. pulchra); 1959:35 (var. pulchra); Herbst, 1962:88–89 (var. pulchra); Ponyi, 1962:136, Figure 4 (var. pulchra).

353 Material. Several tens of females from University Pond (Brisbane, Queensland, Australia). Preparations: MGU – female 1378, 406. ZIN – female 53877 (415).

Female. Valves with pits. Plate of labrum with rounded anterior margin. Claws with a basal spine. Length to 0.43 mm.

Distribution. Europe, Queensland (Australia).

6g. Alona rectangula serrata Daday, 1908 (Figure 405)

Daday, 1908b:211 (var. serrata); 1910b:133, Plate 7, Figures 12, 13, 14 (var. serrata).

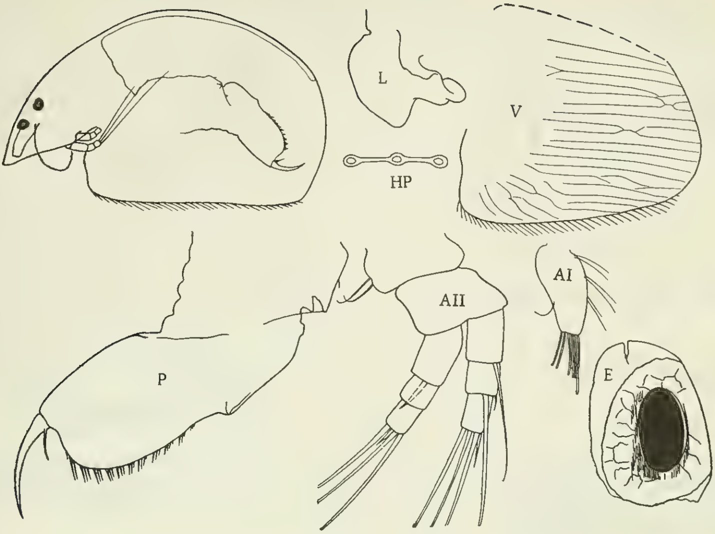

FIGURE 402. Alona rectangula novae-zealandiae, female, length 0.39 mm (Browne Lake, Southern Australia, 26 March 1964):

E — length of egg 160 μ, preparation 1547, view from the left side; P — preparation 1575.

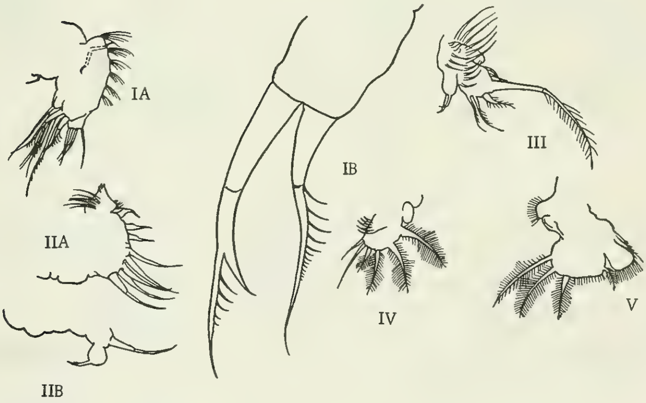

FIGURE 403. Legs of female of Alona rectangula novae-zealandiae:

Ia, V — right legs, outer side— IB — outer branch of endite of right leg I, outer side; IIA, IV — right legs, inner side; IIB — exopodite; III — right leg, ventral.

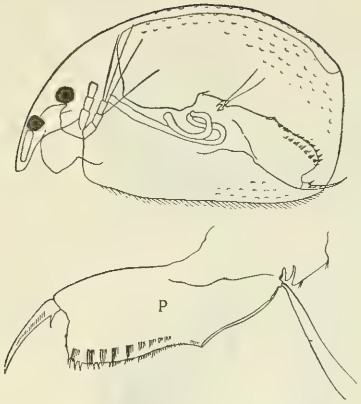

FIGURE 404. Alona rectangula pulchra, female, length 0.34 mm (Australia, Queensland, Brisbane, University Pond, 29 September 1964, preparation 406)

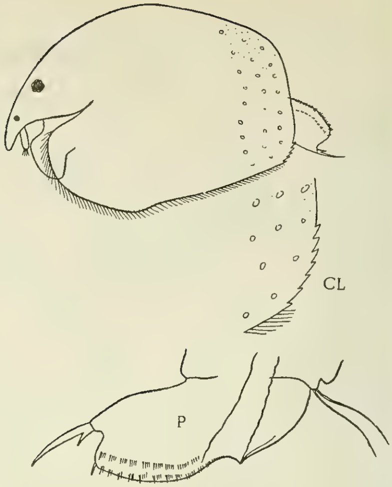

FIGURE 405. Alona rectangula serrata, female (after Daday, 1910b)

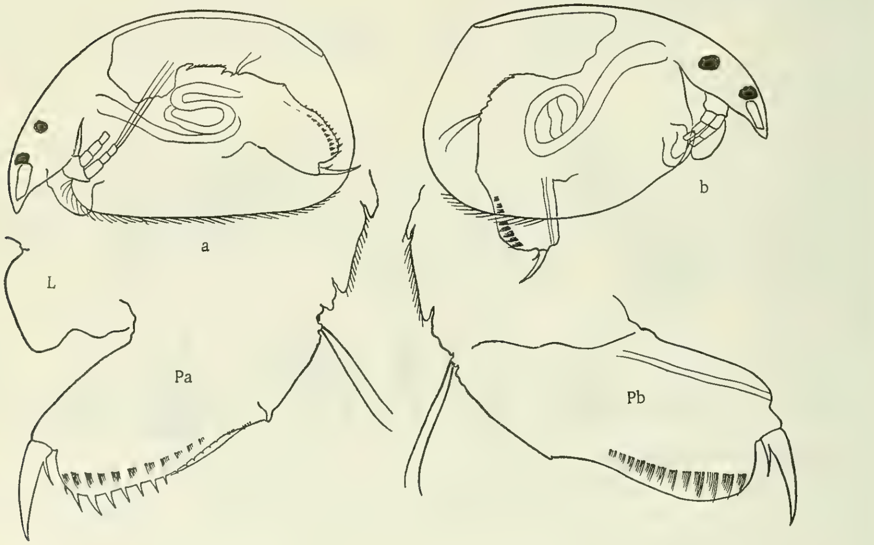

FIGURE 406. Alona setosocaudata (Lake Baikal near the rivers Utulik and Murina):

a — female, length 0.53 mm, 28 July 1964, preparation 2109; L — preparation 1736; Pa — preparation 2109; b — male, length 0.43 mm, 25 February 1965, preparation 200; Pb — postabdomen.

Female. Valves with tubercles. Posteroventral corner of valves rounded, with 5–6 denticles. Plate of labrum rounded. Postabdomen with rounded distal dorsal corner. Anal denticles 7–8, accompanied by 1–3 setae and decreasing in size proximally. Seven to eight groups of setae laterally. Length 0.4 mm.

Distribution. West Africa.

7. Alona setosocaudata G. L. Vasiljeva and N. N. Smirnov, 1969 (Figure 406)

Vasil'eva (Vasiljeva) and Smirnov, 1969:193–195, Figure 5.

Material. Numerous females from Lake Baikal; several males and a juvenile male from Lake Baikal.

Holotype. MGU – female 2109, male 200.

Paratypes. ZIN – female 53846/1736. BGI – female 1801. British Museum No. 68. June 1969.

Female. 2253. Valve without distinct sculpture. Posterodorsal and posteroventral corners of valves rounded, without denticles. Antennules ending slightly before apex of rostrum. Setae on antennae: 0–0–3/1–1–3, spines 1–0–1/0–0–1. Plate of labrum rounded, in one specimen (preparation 2109), with a steplike process on the anterior margin. Head shield with rounded anterior and posterior margin. Three main head pores with a narrow connection between them. Small pores situated near main pores.

Postabdomen wide. Postanal corner blunt, maximum width in middle of postabdomen. Preanal corner not projecting. Ratio between distance from preanal corner of postabdomen to base of claws and maximum width of postabdomen 1.67. Anal denticles isolated, well developed, 7 on the postanal margin and proximal to them 6 small denticles passing on to the anal margin. Distal margin of postabdomen with a small denticle near the last large anal denticle. Anal setae well developed, in 11 groups. Claws with a basal spine. Basal spine as long as basal width of claw. Dorsal side of penultimate abdominal segment smooth, with dense setae. Outer branch of endite of leg I with 2 long setae and a short (inner) seta. Endite of leg II with setae characteristic of the genus Alona in number and form. Endite of leg IV with 4 hard setae; sensilla spherical. Ocellus nearly as large as eye. Length 0.53 mm.

Male. Posterodorsal and posteroventral corner of valves rounded, without denticles. Valves with slightly depressed anterior margin. Antennules ending slightly before apex of rostrum. Plate of labrum rounded. Postabdomen rectangular; vas deferens opening at base of claws, ventral to it. Preanal corner projecting. Anal denticles absent. Lateral setae well developed, in about 12 groups. Claws with a basal spine; width of spine equal to basal width of claw. Dorsal side of penultimate abdominal segment smooth and with dense setae. Eye and ocellus of about equal size. Length 0.43 mm.

This species is closely related to the group of Alona rectangula. It differs from related species in the well developed groups of lateral setae and large isolated anal denticles, in its relatively large size and in the dense setae on the dorsal surface of the penultimate abdominal segment.

Juvenile male. Vas deferens opening on ventral side of postabdomen some distance from base of claws.

356 Distribution. Baikal, open littoral between the rivers Utulik and Murina, Bol'shie Koty inlet.

Biology. Found at a depth of 1 to 133 m on sand, stone and silt bottom. This species is second only to Chydorus piger in its frequency in the Baikal mesobenthos. Parthenogenetic females occur from March to October, ephippial males and females in August.

8. **Alona macrocopa** Sars, 1895 (Figure 407)

Sars, 1895:20–23, Plate III, Figures 11–15; Gurney, 1927:75–76, Figures A–D (Alonella).

Material. According to description.

Female. Dorsal side slightly more strongly convex than ventral side. Valves with about 15 longitudinal lines. Antennules ending slightly before apex of rostrum. Spines on antennae: 1–0–1/1–1–1. Plate of labrum rounded. Postabdomen with obliquely truncate distal end, distinct preanal corner and anal and lateral setae. Claws with basal denticle. Ocellus smaller than eye. Length to 0.39 mm.

Male. Valves with rounded posteroventral corner with denticles, according to Gurney (1927). Posterodorsal corner of valve distinct. Postabdomen tapering distally; preanal corner not differentiated; anal denticles absent. Lateral setae present. Claw without basal denticle. Ocellus situated halfway between eye and apex of rostrum. Vas deferens opening at base of claws, ventral to it. Length 0.28 mm.

Distribution. Australian Region.

9. **Alona arcuata** Sars, 1916 (Figure 408)

Sars, 1916:333, Plate XXXIX, Figures 3, 3a.

Material. According to description.

Female. Valves with blunt posterodorsal corner. Posteroventral corner rounded, without denticles. Valves with longitudinal lines, also with transverse lines in anteroventral part. According to Brehm (1933b), valves with 15 longitudinal lines. Antennules not reaching apex of rostrum. Preanal corner distinct, obtuse-angular. Postanal denticles small. Ocellus smaller than eye, closer to eye than to apex of rostrum. Length to 0.43 mm.

Male. Unknown.

Distribution. South Africa.

10. **Alona crassicauda** Sars, 1916 (Figure 409)

Sars, 1916:335, Plate XL, Figures 1, 1a.

Material. According to description.

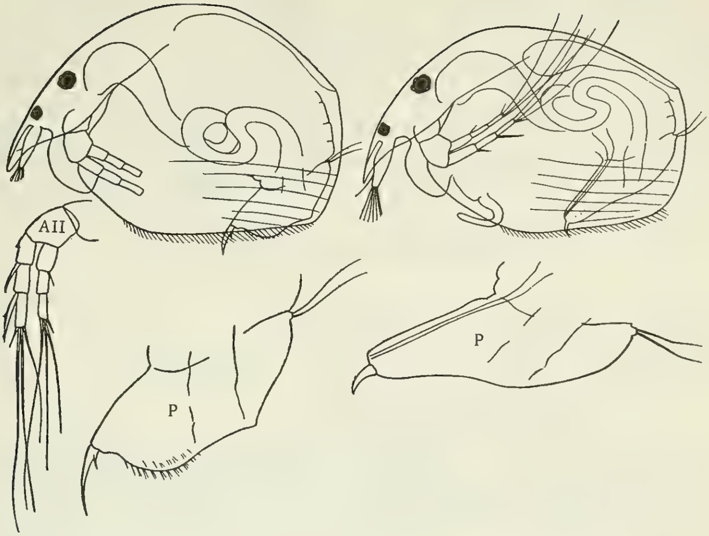

FIGURE 407. Alona macrocopa, female and male (after Sars, 1895)

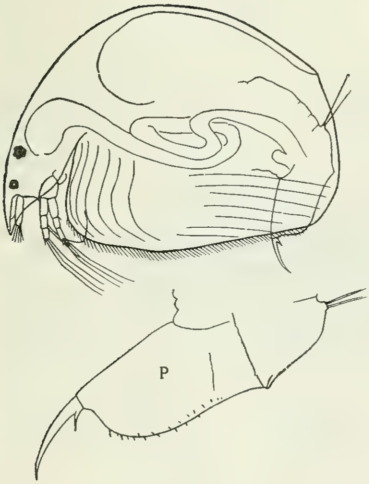

FIGURE 408. Alona arcuata, female (after Sars, 1916)

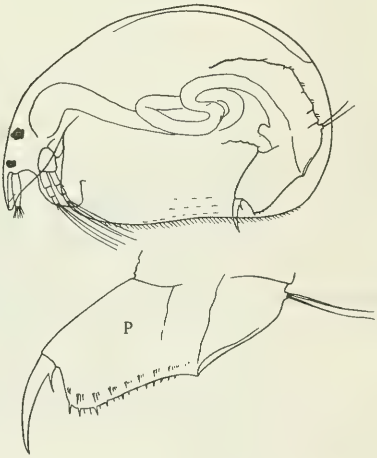

FIGURE 409. Alona crassicauda, female (after Sars, 1916)

Female. Valves with rounded posterodorsal and posteroventral corner. Valves with indistinct lines, with barely visible reticulation. Antennules almost reaching apex of rostrum. Postabdomen with distinct preanal corner in about middle of dorsal side. Two–three distal postanal denticles larger than the others. About 8 lateral groups of setae. Claw with a basal denticle.

According to Brehm (1933b), 4 postanal denticles are larger than the others, and there are 7 lateral groups of setae. Ocellus smaller than eye, slightly nearer to eye than to apex of rostrum. Length 0.48 mm.

Male. Unknown.

Distribution. South Africa.

11. Alona striolata Sars, 1916 (Figure 410)

Sars, 1916:333–334, Plate XXXIX, Figures 4, 4a.

Material. According to description.

Female. Posteroventral corner of valves rounded, without denticles. Valves with dense longitudinal lines continuing onto the head shield. Antennules ending slightly before apex of rostrum. Postabdomen with distinct preanal corner. Anal denticles absent. About 12 lateral groups of setae. Claw with a basal denticle. Ocellus smaller than eye, nearer to eye than to apex of rostrum. Length to 0.48 mm.

Distribution. South Africa.

12. Alona monacantha Sars, 1901

Material. According to description.

Female. Valves with 12–15 longitudinal lines. Posteroventral corner of valves with denticles. Plate of labrum rounded, sometimes with an in-
357 cision or a small denticle on the anterior margin. Postabdomen with anal denticles and lateral setae. Ocellus smaller than eye, situated halfway between eye and apex of rostrum. Length to 0.45 mm.

Male. Posteroventral corner of valves with a denticle. Antennule ending slightly before apex of rostrum. Plate of labrum rounded. Vas deferens opening at base of claws ventrally. Postabdomen without anal denticles, lateral setae present. Ocellus smaller than eye. Length 0.28 mm.

359 Key to Subspecies of A. monacantha according to Females

1 (2). Posteroventral corner of valve with a single denticle . . . . 12a. A. monacantha monacantha Sars, 1901.
2 (1). Posteroventral corner of valve with 2–3 denticles . . . . 12b. A. monacantha tridentata Stingelin, 1905.

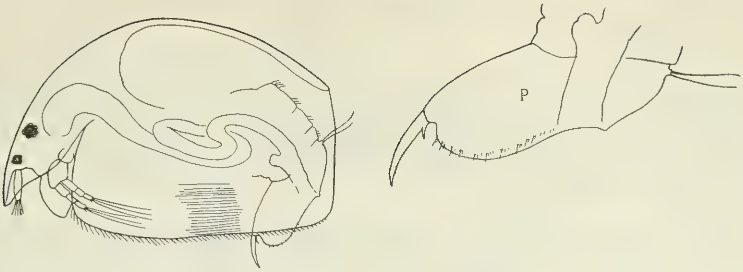

FIGURE 410. Alona striolata, female (after Sars, 1916)

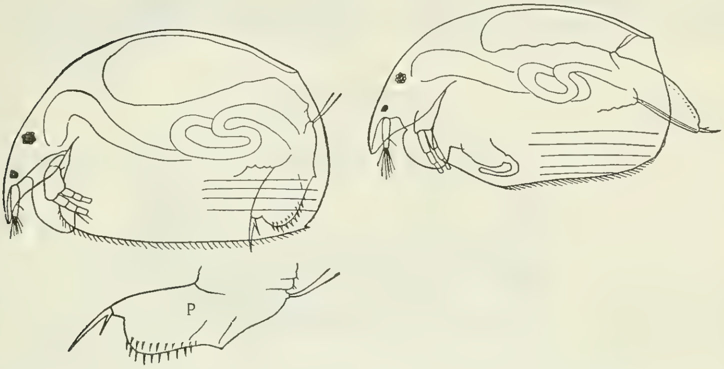

FIGURE 411. Alona monacantha, female and male (after Sars, 1901)

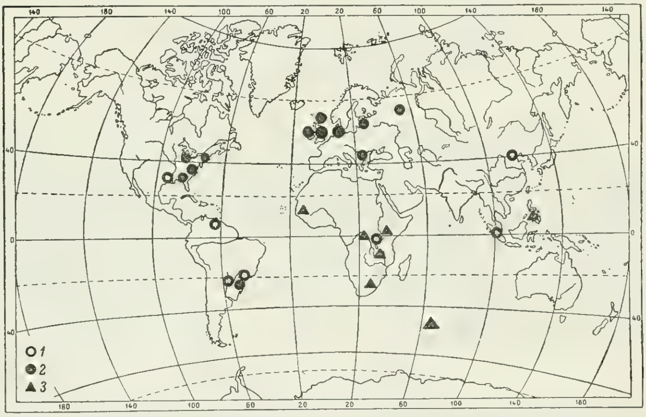

FIGURE 412. Distribution:

I – Alona monacantha monacantha; 2 – A. rustica rustica; 3 – A. bukobensis.

12a. Alona monacantha monacantha Sars, 1901 (Figures 411, 412)

Sars, 1901:54–55, Plate IX, Figures 5, 5a, 5b (monacantha); 1903b:15, Plate I, Figures 5, 5a–c (acuticostata); Daday, 1910b:133, Plate 7, Figures 8–11 (rectangula var. monacantha); Spandl, 1926a:103–104, Figures 5a, b, c (reiseri); Brehm, 1957:230–237, Figures 1–4 (monacantha).

Female. Posteroventral corner of valves with a single denticle.
Distribution. Ethiopian and Neotropical regions. East China, Sumatra.

12b. Alona monacantha tridentata Stingelin, 1905 (Figure 413)

Stingelin, 1905:349–350, Plate 12, Figures 18–19 (acuticostata var. tridentata); Daday, 1910b (rectangula var. tridentata).

(360)

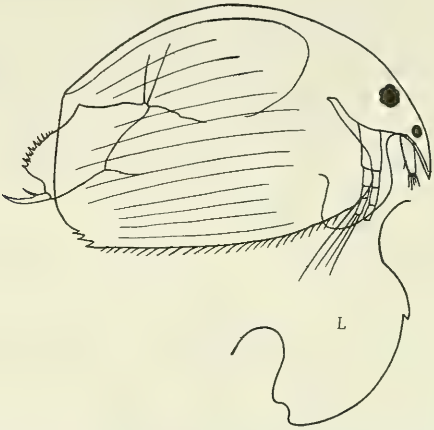

FIGURE 413. Alona monacantha tridentata, female (after Stingelin, 1905)

Female. Valves with distinct posterodorsal corner. Ventral margin almost straight. Posteroventral corner with 2–3 denticles. Valves with about 13 longitudinal lines. Plate of labrum with a denticle on anterior margin. Postabdomen with distinct preanal corner. Anal denticles 8–10. Claws with a long basal spine. Length to 0.22 mm. It differs from the nominate subspecies in the greater number of denticles on the posteroventral corner of the valves and in the small anal denticles.
Distribution. Thailand.

13. Alona circumfimbriata Megard, 1967 (Figure 414)

Megard, 1964:534, Figures 7–8, 10–11 (aff. monacantha); 1967:37–50, Figures 1–6, Plate I, Figures 1a, b.

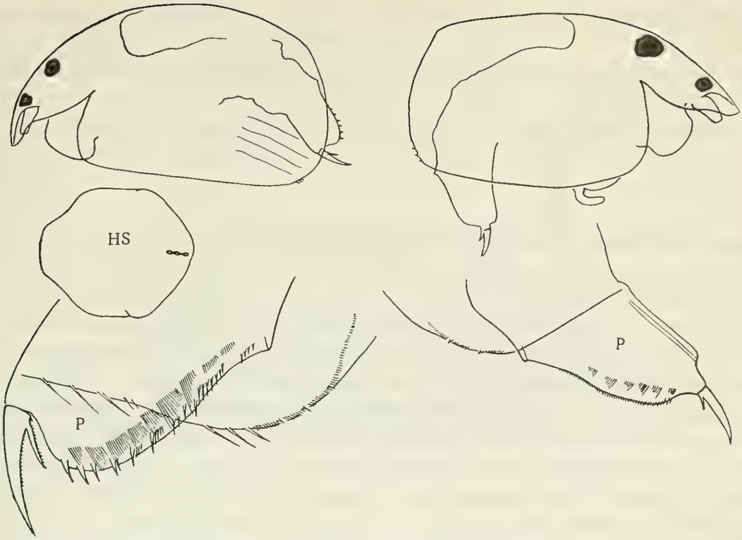

FIGURE 414. Alona circumfimbriata (after Megard, 1967)

Material. Holotype, British Museum 68. 1966. 3. 21. 3.

Female. Maximum height in the middle. Head and dorsal side forming smooth curve. Valves with slightly convex posterior margin and straight ventral margin. Posteroventral corner of valves with 3–6 spine-shaped setae. Posteroventral part of valve with 5–6 longitudinal lines. Antennules distinctly ending before apex of rostrum. Plate of labrum with broad apex.

Maximum width of postanal part of postabdomen slightly less than half length of postabdomen. Preanal corner projecting. A rounded corner between postanal and distal margin of postabdomen. Anal denticles in 6–8 groups, proximal groups with 3–4 denticles, distal groups with 2–3 denticles. Anal margin with irregularly spaced spinules. Lateral setae in 7 groups, the distal seta the longest in each group; in the posterior groups, this seta reaches to or projects beyond the dorsal margin of the postabdomen. Basal spine of claws about half as long as claws.

Head shield with rounded anterior and posterior margin. Three main head pores, narrowly connected. Small pores situated lateral to the median main pore, at about half the distance between the marginal main pores. Main pores situated close to posterior margin of head shield (much closer than distance between marginal main pores). Ocellus situated halfway between eye and apex of rostrum. Length 0.3 mm.

Male. Height of posterior margin of valve slightly less than maximum height of body. Rostrum blunt. Armature of posteroventral corner of valve as in the female. Antennules not reaching apex of rostrum. Ocellus situated nearer to apex of rostrum than to eye.

Postabdomen with projecting preanal corner. Anal and postanal margin with spinules. Groups of lateral setae present. Vas deferens opening on ventral side of postabdomen some distance from base of claws. Form of postabdomen resembling that of A. rectangula. Antennae and legs not described.

Distribution. Minnesota, New Mexico, Michigan, Indiana, South Carolina, Florida.

This species is closely related to A. monacantha and to the group of A. rectangula.

14. Alona holdeni Green, 1952 (Figure 415)

Green, 1952:424, Figures 18–22.

Material. According to description.

Female. Body 1.5 times as long as high. Antennules not reaching
apex of rostrum. Valves with 27–30 longitudinal lines. Three main head
360 pores, connected. Proximal segment of endopodite of antenna with a spine
which almost reaches the distal end of the third segment. Plate of labrum
rounded. Postabdomen with lateral groups of setae, setae of distal group
reaching margin of postabdomen. Claws with a basal spine. Ocellus
slightly smaller than eye.

(361)

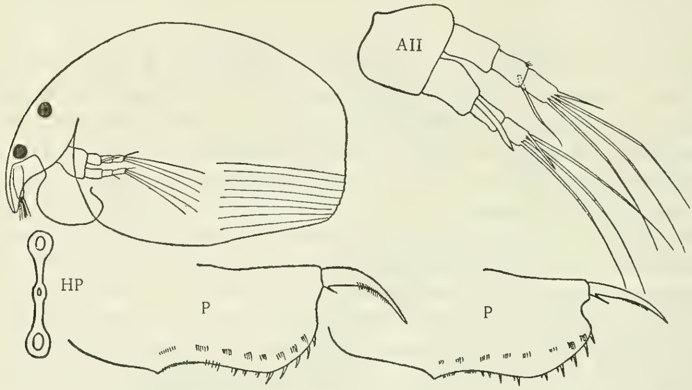

FIGURE 415. Alona holdeni, female (after Green, 1952)

Male. Unknown.

Distribution. Tributary of middle reaches of Niger River.

15. Alona rustica Scott, 1895

Female. Valves with rounded posteroventral and posterodorsal
corner. Valves with 15 longitudinal lines (Brehm, 1933b). Nine anal
361 denticles, 6 lateral groups of setae. Ventral margin of valve almost straight.
Rostrum blunt. Three connected main head pores. Antennules not reaching
apex of rostrum; anterior margin of antennules with incisions, each
with a spine. Posterior margin of antennules with a sensory seta and a

sensory papilla in distal part. Antennae with a spine on proximal segment of exopodite and on both distal segments.

Postabdomen narrowing distally; distal dorsal corner rounded, projecting beyond base of claws. Preanal corner distinct. Anal margin concave, with groups of setae. Dorsal margin of postabdomen with 2 rows of 9–12 anal denticles which decrease in size proximally and continue near the anus in form of 2–3 groups of setae. Ocellus nearer to eye than to apex of rostrum.

Male. According to Myaemets (1960) ventral margin of valve almost straight, with setae. Rostrum blunt. Valve with longitudinal lines. Antennules not reaching apex of rostrum. Anterior margin of antennules with 2 incisions with spines and with a distal spine. Eight sensory papillae distally. Posterior margin with setae and a sensory papilla distally. Postabdomen tapering distally. Distal end rounded. Postanal margin with setae. Claws with one basal spine. Ventral to the claw is a penislike process which is $^3/_4$ as long as the claw; the vas deferens opens at its apex.

Biology. Flössner (1967b) considers A. rustica and A. costata as twin species distinguished by small morphological details. A. rustica is bryobiont living in acid water with a low calcium content, while A. costata inhabits eutrophic and oligotrophic water which contains calcium and has a neutral to slightly acid reaction. According to Flössner A. rustica belongs to the fauna of the conifer forest zone and A. costata to the fauna of European mixed leaf-bearing forests. Flössner considers the West European and Central European populations of A. rustica as postglacial relicts. We found that A. rustica and A. costata differ markedly in the morphology of the legs.

Key to Subspecies of A. rustica according to Females

1 (4). Ocellus not smaller than eye.
2 (3). Valves without tubercles . . . . . . 15a. **A. rustica rustica** Scott, 1895.
3 (2). Valves with tubercles. . . 15b. **A. rustica tuberculata** Mäemets, 1958.
4 (1). Ocellus smaller than eye . . . . 15c. **A. rustica americana** Flössner and Frey, 1970.

15a. **Alona rustica rustica** Scott, 1895 (Figures 412, 416–418)

Scott, 1895:189–190, Plate 5, Figures 5, 17; Sars, 1901:49–51, Plate IX, Figures 2, 2a–c (iheringi); Mäemets, 1958b:260–264, 269–271, Figures 1, 3, photomicrographs 1, 2 (estonica); 1960: 35 – 40, Figure 1, photomicrographs 1, 2 (estonica); Frey, 1965b: 162–169, Figures 7–22; Flössner, 1967:443–444, Figure 2 (rustica).

363 Material. Numerous females from Lake Lemty in the Pechora basin. Preparations: MGU – female 1816. ZIN– female 53878 (1814), 41172, male 41172. British Museum 68. 1963. 3. 22. 1.

Female. Valve without tubercles. Antennules not reaching apex of rostrum. Margin of antennules with 4 incisions. Setae on antennae:

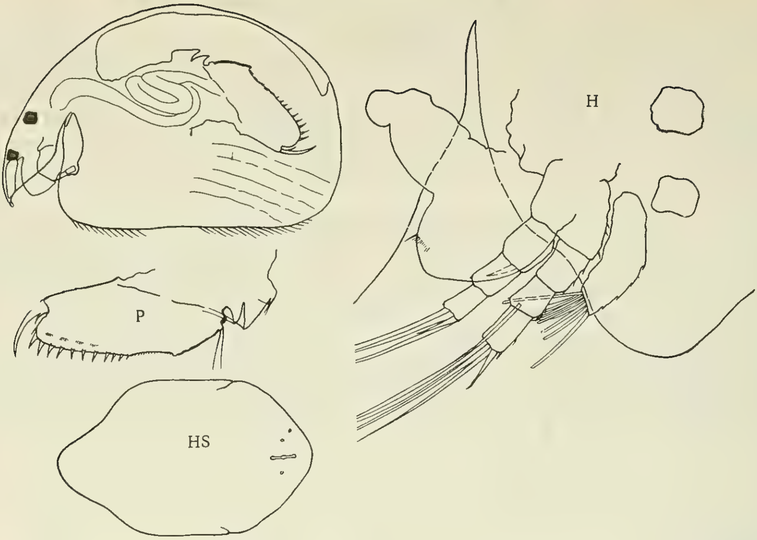

FIGURE 416. Alona rustica rustica, female, length 0.44 mm (Lake Lemty, Pechora basin, 20 August 1964):

H – head, ventral (labrum, left antennule and antenna), left side; P – preparation 1816; HS – after Frey, 1965b.

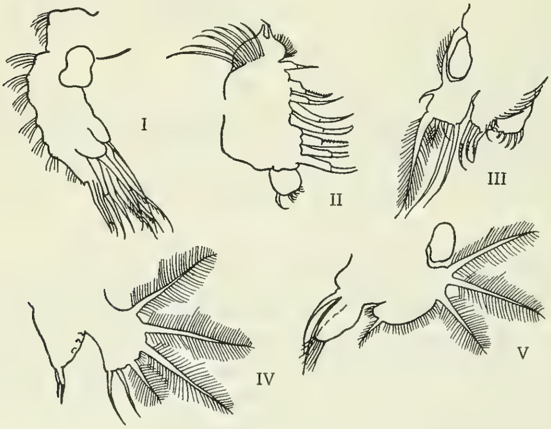

FIGURE 417. Legs of female of Alona rustica rustica (Lake Lemty, Pechora basin, 20 August 1964):

I, IV, V – left legs, outer side; II – right leg, inner side;
III – left leg, inner side.

0–0–3/0–1–3, spines 1–0–1/0–0–1. Plate of labrum broadly rounded, with a row of small setae posteriorly. Length 0.44 mm.

Distribution. Holarctic and Neotropical regions. USSR: Baltic Region, Pechora basin.

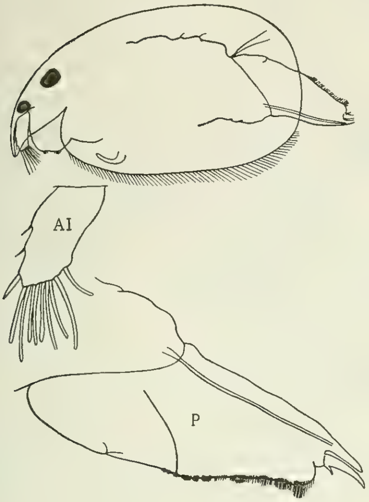

FIGURE 418. Alona rustica rustica, male (after Myaemets, 1960)

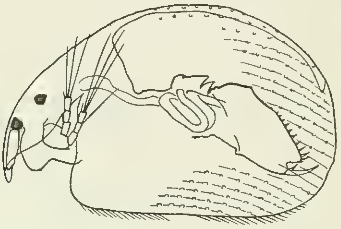

FIGURE 419. Alona rustica tuberculata, female, length 0.37 mm (Lake Lemty, Komi ASSR, 20 August 1964, preparation 1822)

15b. **Alona rustica tuberculata** Mäemets, 1958 (Figures 419, 420)

Mäemets, 1958b:262, Figure 1(4) (estonica f. tuberculata).

Material. Five females and one male from Lake Lemty (Komi ASSR). Preparations: MGU – female 1822, male 2085. ZIN – female 53879 (1818), 41172.

Female. Valve pitted. This form was known to Scott (1895) who did not name it and stated only that the carapace is marked with coarse pits (guttae) which resemble those of Alona guttata but are coarser (l. c., p. 190). Length 0.37 mm.

Male. Valves and head shield pitted. Antennules not reaching apex of rostrum. Distal segments of antennae projecting markedly beyond apex of antennules. Postabdomen narrowing distally. Distal dorsal corner of postabdomen rounded. Postanal margin with groups of setae. Preanal corner distinct but not projecting. Claws with one basal spine. Vas deferens opening at base of claws, ventral to it. Length 0.36 mm.

Distribution. Scotland. USSR: Estonia, Komi ASSR.

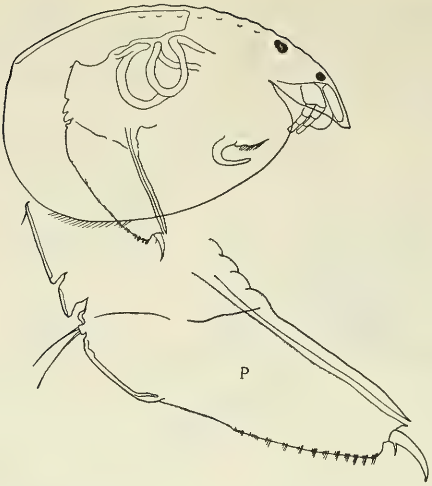

FIGURE 420. Alona rustica tuberculata, male, length 0.36 mm (Lake Lemty, Pechora basin, 20 August 1964, preparation 2085)

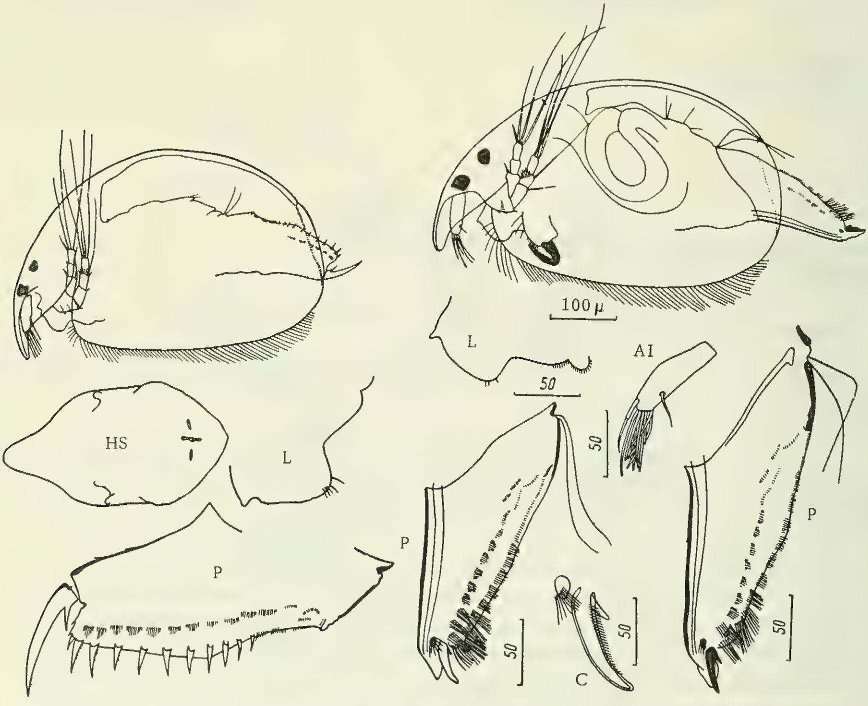

FIGURE 421. Alona bicolor, female – after Frey, 1965b; male – after Frey, 1969a

16. Alona bicolor Frey, 1965 (Figure 421)

Frey, 1965b:159–172, Figures 23–29.

Material. According to description.

Female. Posterodorsal and posteroventral corner of valves rounded. Valves indistinctly reticulate, sometimes with tubercles. Ventral margin with setae its whole length. The 14–15 anterior setae 2–3 times as long as the following. A row of small setae parallel to posterior margin of valve. Rostrum long, with blunt apex. Three connected main head pores. Lateral pores transverse. Antennules and ends of esthetascs not reaching apex of rostrum. Plate of labrum with incisions, its posterior margin with 2 groups of setae. Postabdomen with distinct preanal and postanal corner. Dorsal distal corner projecting, rounded. Ten—eleven anal denticles. Distal margin of postabdomen with 1–3 small denticles. Anal margin with 3 groups of setae. Lateral groups of setae indistinct, the middle seta the longest in each group. Ventral margin with 2 incisions. Claws and basal spine bare. Ocellus larger than eye, situated nearer to eye than to apex of rostrum. Coloration yellow; area of brood chamber colorless. Length to 0.62 mm.

365 Male. According to Frey (1969a:380–386), ratio of length:width 1.7–1.8. Valves indistinctly reticulate, with pale dots. Plate of labrum with a blunt denticle on the anterior side and an incision below the denticle. Sensory papillae of antennule projecting beyond apex of rostrum. Antennules with an articulated sensory seta on the anterior side near the apex. Twelve sensory papillae of different length. Second sensory seta unsegmented, situated on posterolateral surface of antennule at a quarter of its length from the apex. Setae on antennae: 1–1–3/0–0–3.

Postabdomen tapering distal to anus. Anal denticles setalike, in groups. The length of the setae increases distally. Lateral setae in groups, their length increasing distally. Setae of both terminal groups of lateral setae projecting distinctly beyond margin of postabdomen. Base of claws with a group of setae. Anal margin with groups of short setae. Ratio of length: width of postabdomen 2.8–2.9. Penis conical. Claws with a basal spine. Ocellus larger than eye. Length to 0.53 mm.

The characters of the male prove that A. bicolor is more closely related to A. rustica than to A. costata. A. bicolor and A. rustica are a better example of twin species than A. rustica and A. costata.

Biology. A. bicolor inhabits lakes with soft, transparent water, on steep open shores in areas with granite boulders. It occurs together with A. rustica and A. costata or with one of them.

Distribution. New England (U.S.A.).

17. Alona virago Brehm, 1935 (Figure 422)

Brehm, 1935c:120–121, Figures 2a–b.

Material. According to description.

Female. Valve densely punctate. Posterodorsal and posteroventral corner rounded. Antennules not reaching apex of rostrum; esthetascs

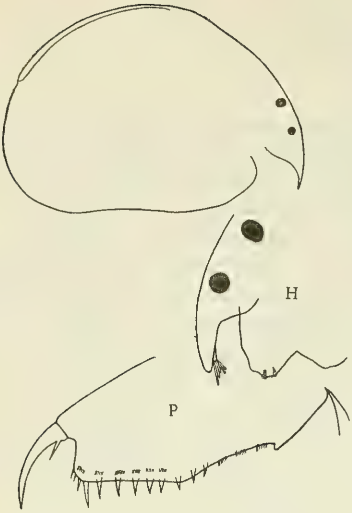

FIGURE 422. Alona virago, female (after Brehm, 1935c)

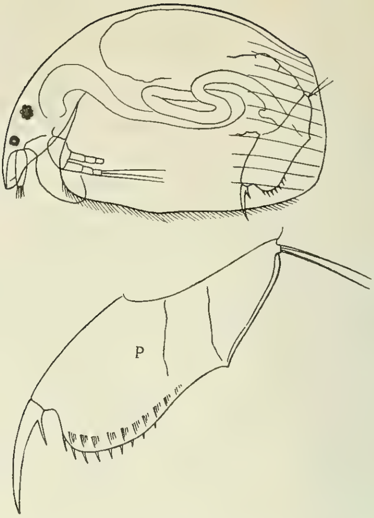

FIGURE 423. Alona bukobensis, female (after Sars, 1916)

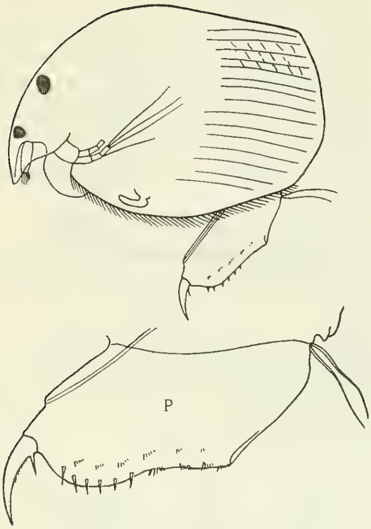

FIGURE 424. Alona bukobensis, male (after Gauthier, 1928a)

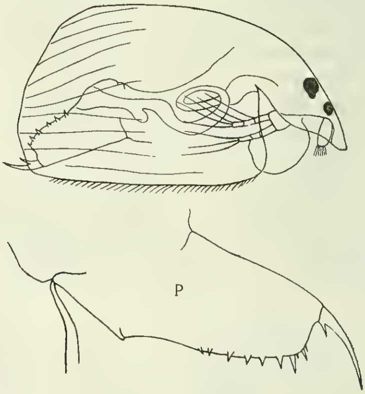

FIGURE 425. Alona weltneri, female (after Keilhack, 1905)

reaching to apex of rostrum, some of them projecting beyond it. Labrum with 2 groups of setae. Postabdomen with angular middle of dorsal margin. Nine anal denticles, 1–2 of them proximal to the angular process. About 5 groups of setae laterally. Ocellus and eye almost equally large.

Male. Unknown.

Distribution. Northeast China, southern Chile.

18. **Alona bukobensis** Weltner, 1896 (Figures 412, 423, 424)

Weltner, 1896:1–11, Figures 16, 17, 18, 20, 32 (bukobensis); Ekman, 1904a:10–14, Figures 5–10; Daday, 1910b:132, Plate 7, Figures 15, 16 (rectangula var. bukobensis); Sars, 1916:336–337, Plate XL, Figures 3, 3a (bukobensis); Vereshchagin, 1916:18, Figures 12, 13 (rectangula var. bukobensis); Fryer, 1957:230.

Material. According to description.

Female. According to Brehm (1933b), valves with 20–25 longitudinal lines. Anal denticles of postabdomen in 7 groups. Lateral groups 7–10. Length 0.8 mm.

Fryer (1957) stated that the definition of this species should be based on the description and figures of Sars (1916), as those of Weltner (1896) are not satisfactory. According to Weltner (1896), the ratio of length:height is 3:2, rostrum blunt, antennules not reaching apex of rostrum, esthetascs of different length, setae on antennae: 0–0–3/0–1–3, spines 1–0–1/0–0–1, valves with 10–12 longitudinal lines, with indistinct connections between the lines and dots; posterodorsal corner of valve forming an angle of about 135°, posteroventral corner rounded; preanal corner of postabdomen projecting, dorsal distal corner of postabdomen rounded; about 9 irregularly distributed anal denticles. Claws with a basal spine and with setae on the concave margin. Ocellus situated halfway between eye and apex of rostrum. Length to 0.35 mm.

Male. Length 0.26 mm.

Distribution. Lake Victoria.

Biology. Lives in vegetation.

19. **Alona weltneri** Keilhack, 1905 (Figures 425–427)

Keilhack, 1905:142, 158–159, Figures 13, 14 (Weltneri); 1907:464, Figure 20; Scourfield, 1907:72–73, Plate 8, Figures 1–4; 1908:464, Figure 20; 1911:469–472, Figures 5–8; Parenzan, 1932, Plate VI:11 (rectangula var. Weltneri); Bening, 1941:301–302, Figure 124; Herbst, 1962:88, Figure 64.

Material. According to description.

Female. Posteroventral corner of valves rounded. Valves with longitudinal lines. Ocellus situated nearer to eye than to apex of rostrum, smaller than eye. Antennules almost reaching apex of rostrum. Antennae with spines on proximal segment of exopodite and on both distal segments.
367 Plate of labrum rounded. Postabdomen tapering from the middle. Distal margin at right angle to base of claws. Two proximal anal denticles

pressed to the margin, 2 distal denticles longer than the others. Claws smooth or with a distal row of setae, with one basal spine. Length to 0.5 mm.

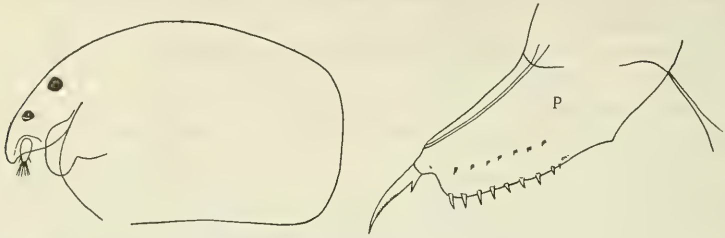

FIGURE 426. Alona weltneri, male (after Flössner, 1962a)

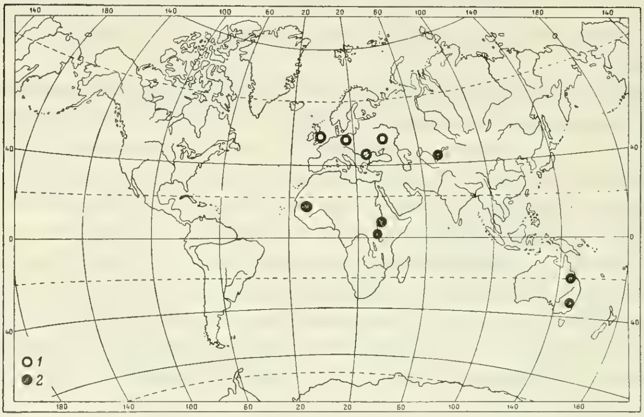

FIGURE 427. Distribution:

a — Alona weltneri; 2 — A. davidi theringi.

Male. Valves with rounded posterodorsal and posteroventral corner. Postabdomen with anal denticles and 7 lateral groups of setae (Flössner, 1962a). Vas deferens opening ventral to the base of the claws, some distance from it. Length 0.4 mm.

Distribution. Western Europe.

368 20. Alona cannellata Brehm, 1934 (Figure 428)

Brehm, 1934a:64–66, Figures 10–11.

Material. According to description.

Female. Valve with longitudinal lines, 10–12 lines at the posterior margin. Claw with a basal spine half as long as the claw. Rostrum blunt. Antennules reaching apex of rostrum. Ocellus situated halfway between eye and apex of rostrum, about half as wide as the eye. Length 0.25 mm.

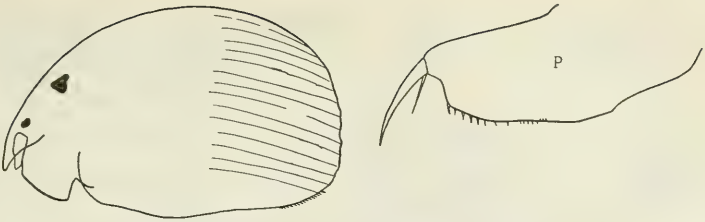

FIGURE 428. Alona cannellata, female (after Brehm, 1934)

Male. Unknown.
Distribution. Niger basin.

21. Alona davidi Richard, 1895

Harding, 1955:345, Figures 65–85 (diaphana) (no subspecies are distinguished).

Female. Maximum height slightly before middle. Dorsal margin of head forming a smooth curve with dorsal margin of valve. Posterodorsal and posteroventral corner rounded. Ventral margin of valve projecting in the middle, with feathered setae passing on the posteroventral corner into a row of short hairs which continues on posterior margin of valve. Rostrum blunt. Antennules ending a short distance before apex of rostrum. Plate of labrum rounded. Postabdomen widest in the middle, tapering distally. Anal margin concave, with setae. Preanal corner projecting. Claws with setae on the concave margin. One basal spine. Ocellus smaller than eye, slightly nearer to eye than to apex of rostrum. Postabdomen with groups of denticles dorsally, with groups of setae laterally (Harding, 1955). Claw with a basal spine and a group of spinules. Examination from the dorsal side shows that the groups of spinules on the dorsal margin of the postabdomen are not situated strictly opposite each other and that the spinules are directed toward the median line. Intestine without caecum (Brehm, 1933b). Length to 0.65 mm.

Male. Maximum height slightly before the middle. Valves with rounded posterodorsal and posteroventral corner. Antennules not quite reaching apex of rostrum.

Postabdomen narrowing distally. Preanal corner almost not projecting. Preanal margin slightly shorter than postanal margin. Vas deferens opening at base of claws ventral to it. Length 0.4 mm.

Key to Subspecies of A. davidi according to Females

1 (2). Valve with a pattern of polygons. Anal denticles in 10–11 groups of 2–4 teeth . . . . 21a. A. davidi davidi Richard, 1895.
2 (1). Valve with lines or dots.
3 (4). Valve with longitudinal lines. Five distal anal denticles isolated, followed by 4 denticles accompanied by a seta, further 4 groups proximally . . . . 21b. A. davidi iheringi Richard, 1897.

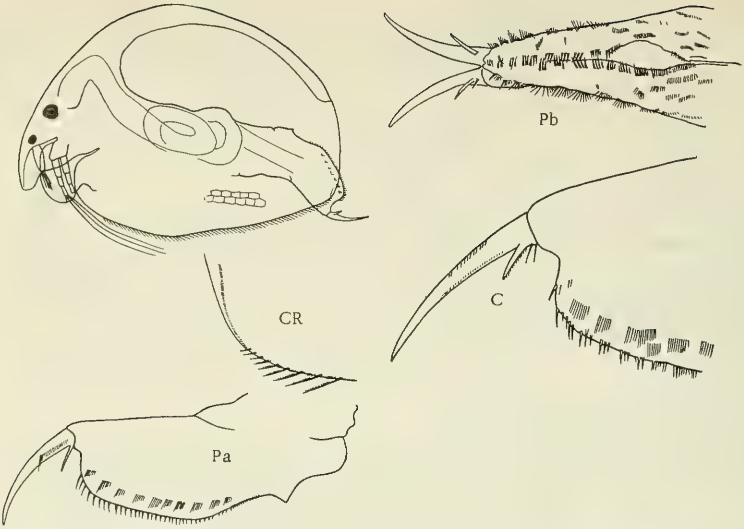

FIGURE 429. Alona davidi davidi, female, left side (after Richard, 1895):

CR, Pa – after Richard, 1895; Pb – dorsal, after Harding, 1955; C – after Harding, 1955.

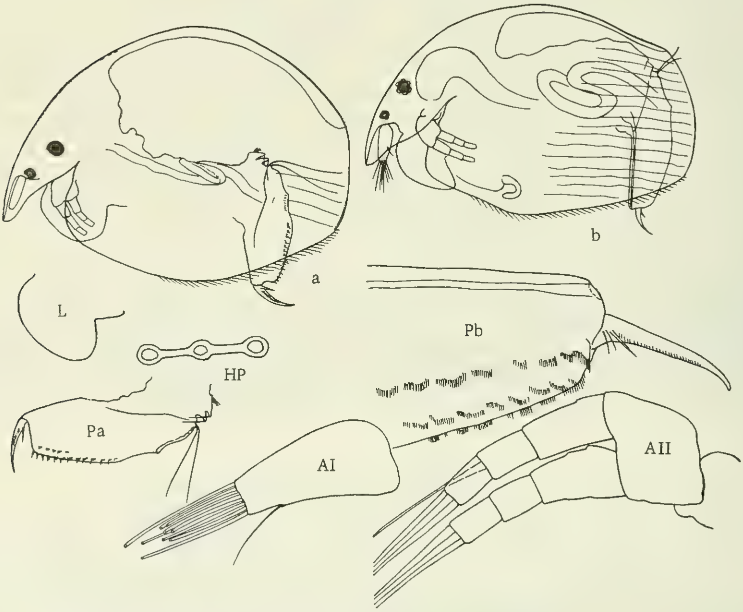

FIGURE 430. Alona davidi iheringi:

a – female, length 0.42 mm (Atkinson Lagoon, Queensland, Australia, 10 June 1959, preparation 1581); HP – upper reaches of the Nile; b – male (after Sars, 1901); Pb – postabdomen of male (after Harding, 1955).

4 (3). Valve with dots (polygons may be present). Anal denticles in about 16 groups . . . . 21c. A. davidi punctata Daday, 1898.

21a. Alona davidi davidi Richard, 1895 (Figure 429)

Richard, 1895:192–195, Figures 5–8 (davidi); Sars, 1901, 60–61, Plate X, Figures 3, 3a–b (Alonella diaphana); Daday, 1910b:122, Plate 6, Figures 6, 7, 8 (Alonella punctata).

Material. Numerous females from the White Nile.

Female. Valve with indistinct pattern of polygons. Inner side of posterior margin of valve with a row of setae ending far from posterodorsal corner. Antennules with esthetascs of different length. Setae on antennae: 0–0–3/1–1–3, spines 1–0–1/0–0–1. Anal denticles thin, in 10–11 groups with 2–4 teeth. Richard (1895) illustrates 35 denticles. Postabdomen with groups of setae laterally, distal seta the longest in each group. Claws with setae in proximal part of concave margin. Length to 0.47 mm.

Distribution. Ethiopian Region, Haiti.

(370)

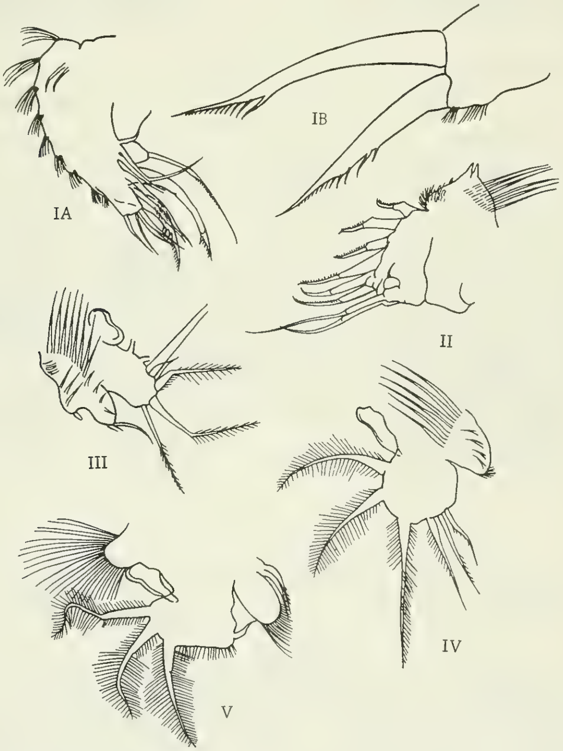

FIGURE 431. Legs of female of Alona davidi iheringi (upper reaches of the Nile):

IA, III – right legs, inner side; IB – outer branch of endite of right leg I, outer side; II – right leg, outer side; IV, V – left legs, inner side.

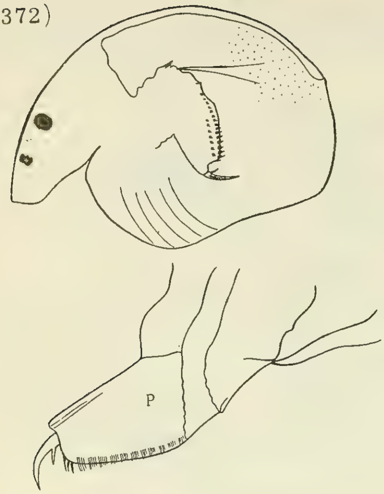

FIGURE 432. Alona davidi punctata, female, length 0.44 mm (White Nile, 19 April 1964, preparation 408):

P — postabdomen of male (after Daday, 1905).

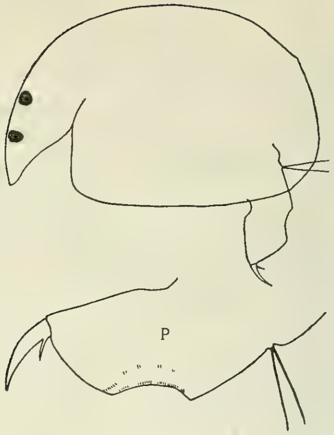

FIGURE 433. Alona inermis, female (after Pesta, 1928)

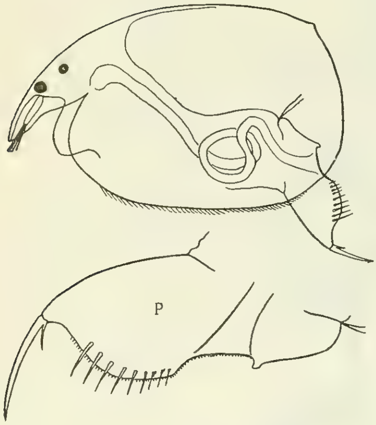

FIGURE 434. Alona inermis, female (after Kiser, 1948)

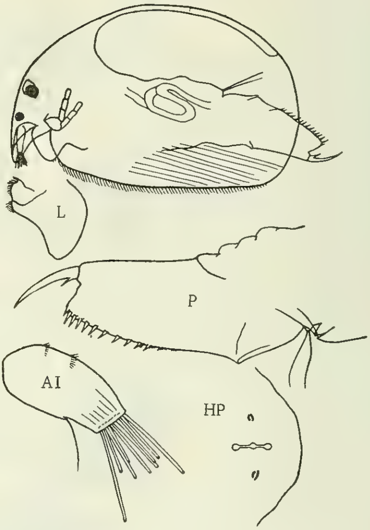

FIGURE 435. Alona costata, female, length 0.56 mm:

P — Uglich Reservoir, 23 July 1962; AI, L — Cherepovets Reservoir, 21 October 1963; HP — after Frey, 1962a.

21b. Alona davidi iheringi Richard, 1897 (Figures 427, 430, 431)

Sars, 1888:47–50, Plate 5, 296, Figures 5–7 (Alonella diaphana); Richard, 1897b:294–296, Figures 42–43 (var. iheringi); Birabén, 1939: 663–665, Figures 17, 18 (Alonella diaphana).

Material. Numerous females from the White Nile; several females from ponds on the Kalgan-Chirchik fish farm near Tashkent; several fe- 370 males from Queensland and New South Wales, Australia. Preparations: MGU – female 1793. ZIN – female 53866 (1444). Ph – female 1797.

Female. Valves with longitudinal lines. Posterior margin of valve with a distinct row of hairs on the inner side, reaching the posterodorsal corner. Claws with setae on the whole concave margin, with a basal spine. Maximum height in anterior third of body (Delachaux, 1917). Five distal, isolated anal denticles, then 4 denticles accompanied by a seta, further 4 groups proximally. Anal denticles 13–14, each accompanied by 2–4 spinules, according to Delachaux (1917). Anal margin with 3–6 groups of setae. Groups of setae laterally. Valves finely punctate. Length to 0.49 mm.

Distribution. Ethiopian and Australian regions, Rio Grande do Sul (Brazil). USSR: Tashkent area.

21c. Alona davidi punctata Daday, 1898 (Figure 432)

Daday, 1898:39–41, Figure 18 (punctata); 1905:163–164, Plate X, Figures 12–17 (Alonella punctata); Delachaux, 1917:86–88, Figures 13–14; Gauthier, 1939:176–182, Figure 10 (var. punctata).

371 Material. Numerous females from the White Nile; one female from Storm King Dam, Queensland, Australia; 2 females from Corrientes, Argentina. Preparations: MGU – female 1792, malformed female 6.

Female. Valve punctate, sometimes also with a pattern of polygons. Rostrum blunt. Antennules ending slightly before apex of rostrum. Postabdomen with about 5 groups of 5–7 anal denticles. About 12 groups of lateral setae. Claws with a basal spine and setae on the concave margin. Length to 0.65 mm.

Distribution. Ethiopian and Australian regions. Corrientes (Argentina).

22. Alona inermis Pesta, 1928 (Figure 433)

Pesta, 1928:79–80, Figures 1c, d.

Material. According to description.

Female. Valves with rounded posterodorsal and posteroventral corner. Posterior half of valves with longitudinal lines. Anteroventral corner of valves forming right angle. Postabdomen short, wide. Anal margin concave, with setae. Preanal and postanal margin of almost equal length. Claws with a basal spine. Ocellus situated halfway between eye and apex of rostrum.

Male. Unknown.
Distribution. South Georgia.

23. Alona milleri Kiser, 1948 (Figure 434)

Kiser, 1948:316, Figures 4, 5.

Material. According to description.
Female. Posterodorsal corner of valve distinct. Posteroventral corner of valves rounded. Valves without sculpture. Antennules not reaching apex of rostrum; sensory papillae slightly longer than rostrum, almost as long as the antennules. Plate of labrum rounded. Postabdomen tapering toward base of claws. Claws with a basal spine about $1/3$ as long as claw. Postanal denticles numerous, short. Long spines laterally. Ocellus almost as large as eye. Length 0.3 mm.
Male. Unknown.
Distribution. Southeast China.

24. Alona costata Sars, 1862 (Figures 435–441)

Sars, 1862b:286; Schoedler, 1862:20–21, Plate I, Figure 23 (lineata); P. E. Müller, 1867:178, Plate IV, Figures 3, 4 (lineata), 184–185, Plate IV, Figure 15 (Phryxura rectirostris syn.n. For a hundred years no one found Ph. rectirostris Müller, 1867. On the other hand, many malformed postabdomens resembling that illustrated by Müller have been described. Because of the resemblance in the description, size and illustration of the postabdomen with the characters of Alona costata (for malformation of the postabdomen of this species see Flössner, 1962a), we consider Phryxura rectirostris Müller, 1867 as a synonym of Alona costata, described after a malformed specimen); Norman and Brady, 1867:28, Plate XVIII, Figure 2, Plate XXI, Figure 7 (Lynceus costatus); Hellich, 1877:90, Figures 47, 48; Matile, 1890:44–45, Figure 34; Lilljeborg, 1900:465–468, Plate LXVIII, Figures 9–15 (Lynceus); Bening, 1941:299–301, Figure 123; Frey, 1959:35, Figures 28, 29; 1962a, Figures 28, 29; Šrámek-Hušek et al., 1962:336–338, Figure 124; Herbst, 1962:86, Figure 61; Chiang Sieh-chin, 1964:82; Shen, Sung and Chen, 1964, Figures 6–8; Frey, 1965b:159–162, Figures 1–6; Negrea, 1966a:141–142.

Material. Numerous females from the Volga reservoirs – Ivan'kovo, Uglich, Rybinsk, Cherepovets, Komi ASSR, Lake Karmak-Kul' in the Aktyubinsk Region, a lagoon on the north shore of Lake Issyk-Kul', Lake Kadil'noe (Lake Baikal, north of Bol'shie Koty), Amur basin, Kunashir Island, New South Wales (Australia); several females from Lake Aram-Kol' and Lake Kyla-Kol' in southern Kirghizia; 2 females from the Sredne-Verzhinskii pond in the Perm Region. Numerous males from the Rybinsk and Cherepovets reservoirs, from a small lake on the north shore of Lake Issyk-Kul'. Preparations: MGU – female 114, ephippial female 2009, malformed females 724, 130, 723, 1418, 1259, 1798, male 126, juvenile male 113. ZIN – female 53862 (877), 53863 (1587), ephippial female 53864 (952), male 53865 (103), juvenile male 127. Ph – female 1624, male 129.

Female. Valves with rounded posterodorsal and posteroventral corner. Valves with longitudinal lines. According to Frey (1959) head shield with 3 connected main pores, lateral pores with chitinous thickenings which are distinctly visible in well preserved specimens (a difference from **Alona guttata**). Head shield with rounded posterior margin. Antennules not reaching apex of rostrum. Anterior margin of antennule with incisions, with a sensory seta and a sensory papilla distal to the middle. Setae on 373 antennae: 0–0–3/1–1–3. Antennae with spines on proximal segment of exopodite and on both distal segments. Plate of labrum rounded. Postabdomen short, tapering distally. Dorsal margin of postabdomen almost straight; preanal corner only slighty projecting. Distal end nearly pointed, slightly projecting beyond base of claws. Anal denticles 9–13, decreasing in size proximally. A row of small groups of setae laterally, the distal seta the longest in each group. Anal margin almost straight. Ocellus smaller than eye, situated halfway between eye and apex of rostrum. Legs typical for the genus. Length to 0.6 mm.

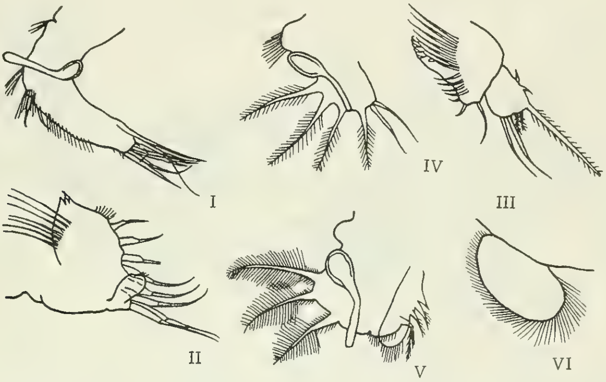

FIGURE 436. Legs of female of **Alona costata** (Cherepovets Reservoir, 21 October 1963):

1 – left leg, outer side; II, IV, V, VI – left legs, inner side; III – right leg, inner side.

Male. Valve with rounded posterodorsal and posteroventral corner. Antennules not reaching apex of rostrum. Antennule with a 2-segmented flagellum distally, and a sensory seta proximal to it. Postabdomen narrowing distally. Vas deferens opening ventrally at base of claws. Anterior side of endite of leg I with a group of thick setae opposite the claw. Outer branch of endite of leg I with 3 setae of equal length (Figure 124). Length to 0.65 mm.

Juvenile male. Postabdomen not tapering distally, with anal denticles. Vas deferens opening some distance from base of claws (Figure 440).

P.E. Müller (1867:184) gives the following definition of the genus **Phryxura** P.E. Müller, 1867: "Head immobile, not separated by an incision from the thorax, and covered with wide shield without a keel. Eye

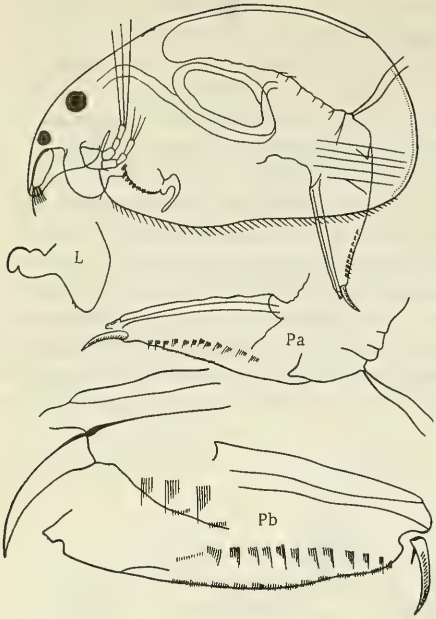

FIGURE 437. Alona costata, male, length 0.41 mm:

Pa – Cherepovets Reservoir, 16 September 1963;
Pb – after Frey, 1965b.

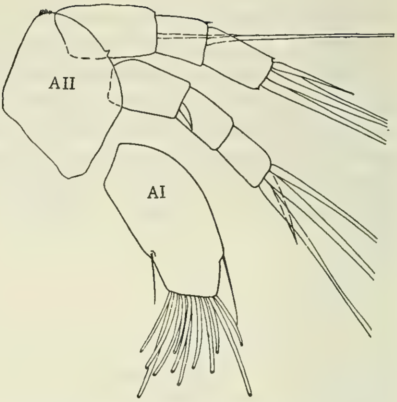

FIGURE 438. Alona costata, male, antennule and antenna

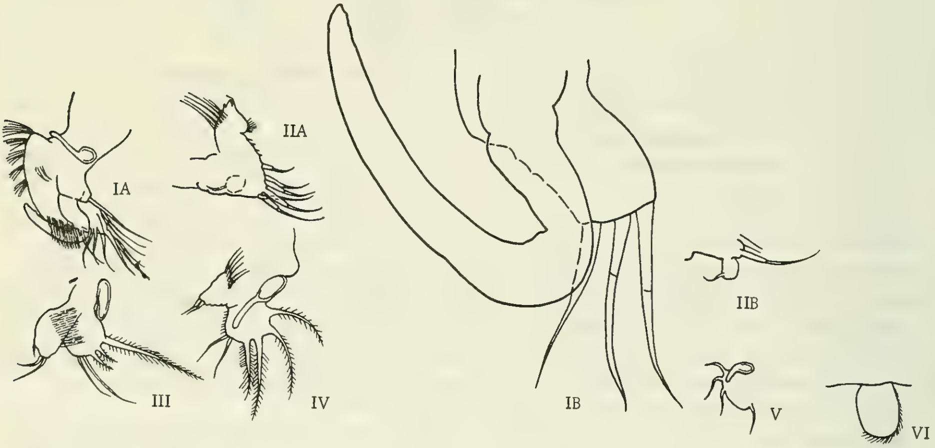

FIGURE 439. Legs of male of Alona costata (Cherepovets Reservoir, 21 October 1963):

IA, III, IV – left legs, outer side; IB – outer branch of endite of left leg I, outer side; IIA – right leg, inner side; IIB – exopodite of right leg II, ventral; V – exopodite and epipodite of right leg, outer side; VI – left leg, inner side.

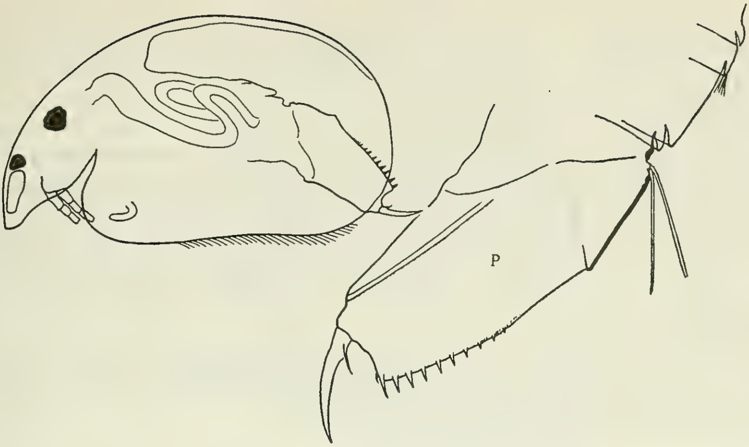

FIGURE 440. Alona costata, juvenile male, length 0.37 mm (Cherepovets Reservoir, Goritsy, 16 September 1963, preparation 127)

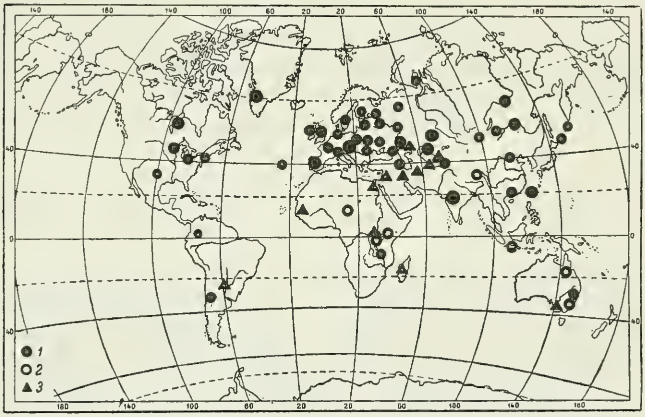

FIGURE 441. Distribution:

1 – Alona costata; 2 – A. pulchella; 3 – A. cambouei.

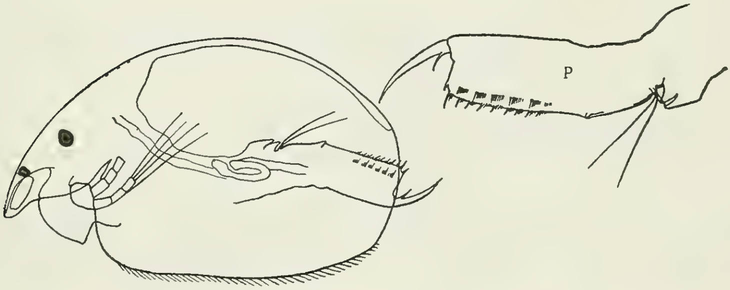

FIGURE 442. Alona pulchella, female (Atkinson Lagoon, Queensland, Australia, 10 June 1959, preparation 1585)

present. Valves wide, oblong. Height of posterior margin slightly less than maximum height of body. Postabdomen moderately large, rounded, with few denticles, blunt end. Claws small, barely longer than the denticles." Müller (1867:184) gives the following description of Phryxura rectirostris Müller, 1867: "Head long, rostrum pointed. Valve oblong, with weak longitudinal lines. Posterior margin straight. Dorsal margin slightly convex, ventral margin slightly rounded, with setae which gradually decrease in size toward the posterior end. Posteroventral corner blunt, without armature." Length to 0.5 mm. It is also stated in the diagnosis of the genus that the head has no keel and that the height of the posterior margin is slightly less than the maximum height of the body. Described after a damaged specimen.

Distribution. Holarctic, Ethiopian, Indo-Malayan and Neotropical regions. European USSR to the Far East on the southern border. No collections have been made in Siberia.

Biology. Lives in vegetation.

25. **Alona pulchella** King, 1853 (Figures 441, 442)

King, 1853:260, Plate VIII, B; Sars, 1888:59–62, Plate 6, Figures 5, 6; 1896b:37–40, Plate 6, Figures 3, 4; Richard, 1897b:289–290, Figures 35, 36 (cambouei var.); Ekman, 1900:74 (cambouei var. patagonica); Daday, 1910b:128–130, Plate 6, Figures 30–35, Plate 6, Figure 2 (pulchella part); Sars, 1916:335–336, Plate XL, Figures 2, 2a; D'Ancona, 1929:288–290, Figure 4; Brehm, 1933a:723–724, Figures 26, 27 (arenaria); Petkovski, 1966, Abb. 11.

376 Material. Several females from New South Wales, Queensland. Preparations: MGU – female 1585. ZIN – female 53871 (1776). Ph – female 1775.

Female. Posterodorsal and posteroventral corner of valves rounded. Valves punctate, without reticulation. Antennules not reaching apex of rostrum. Plate of labrum with convex anterior margin and pointed apex.

Three head pores, not connected (Petkovski, 1966). Postabdomen with parallel dorsal and ventral margin. Preanal corner distinct but not projecting. About 10 anal denticles. Groups of lateral setae present, distal seta the longest in each group. Claws with a basal spine. Intestine forming loops. Ocellus situated halfway between eye and apex of rostrum. Length to 0.39 mm.

Male. Unknown.

Distribution. Australian, Ethiopian and Neotropical regions.

26. **Alona setulosa** Megard, 1967 (Figure 443)

Megard, 1967:37–50, Figures 23–28, Plate I, Figures 3a, b.

Material. Holotype. British Museum 68. 1966. 3. 21. 8.

Female. Valves without sculpture. Posteroventral corner rounded. Plate of labrum with rounded apex. Antennules not quite reaching apex of rostrum.

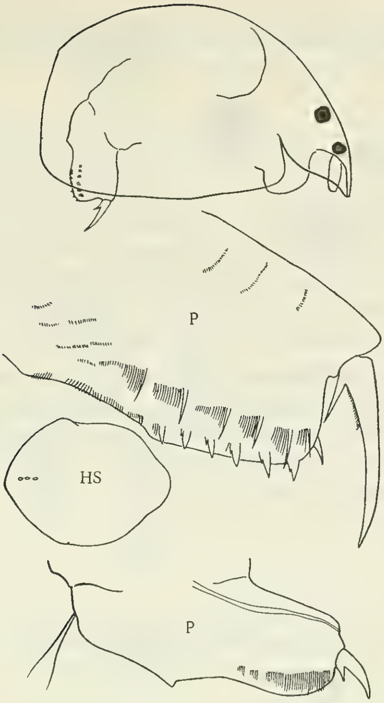

FIGURE 443. Alona setulosa, female, and postabdomen of male (after Megard, 1967)

Postabdomen short. Postanal part nearly square. Postanal corner projecting. Postanal and anal margin of almost equal length. Anal margin with setae. Lateral setae in groups, posterior seta the largest (spine-shaped) in each group. Claws with a basal spine $^1/_4$ as long as the claw and with setae in proximal part of the concave side. Ocellus smaller than eye, situated halfway between eye and apex of rostrum. Head shield with rounded anterior and posterior margin. Three main head pores, incompletely connected. Distance from posterior main pore to posterior margin of head shield shorter than distance between marginal main pores. Small head pores situated lateral to the anterior main pore. Length to 0.42 mm.

Male. Postabdomen with nearly parallel dorsal and ventral margin. Dorsal margin with spinules. Lateral setae well developed, posterior seta the longest in each group (this seta projects beyond the dorsal margin in the distal groups). Claws short, wide, basal spine half as long as the claw. Vas deferens opening on ventral side of postabdomen near base of claws. Postabdomen of male resembling that of Alona rectangula. Length 0.26 mm.

Distribution. Minnesota, New Mexico, Wisconsin, Indiana, Georgia, Florida (U.S.A.).

Alona pulchella King differs in the presence of a complete connection between the main head pores. Small pores situated lateral to the median main pore at the distance between the marginal main pores. According to Megard (1967), the posterior seta of A. pulchella is the longest but not thickened in each lateral group.

377 27. Alona cambouei Guerne and Richard, 1853 (Figures (Figures 441, 444–446)

Guerne and Richard, 1893:242–244, Figures 10–11, 1894a:371–374, Figures 5–8; Sars, 1901:55, Plate 9, Figures 6, 6a (glabra); Ekman, 1904a:8–9 (Lynceus); Daday, 1905:172–173, Plate XI, Figures 1, 2; 173–174, Plate XI, Figures 3, 4 (glabra); 1910b:128–130, Plate VI, Figure 36 (pulchella part); Sars, 1916:335, Plate XL, Figures 2, 2a.

Material. Numerous females from the White Nile, from ponds of the Kalgan-Chirchik fish farm south of Tashkent and from New South Wales, Australia; one female from the Kara-Su River at the confluence with the Zeravshan River and from Lake Chatyr-Kul'. Preparations: MGU – female 1279. ZIN – female 53861 (1538).

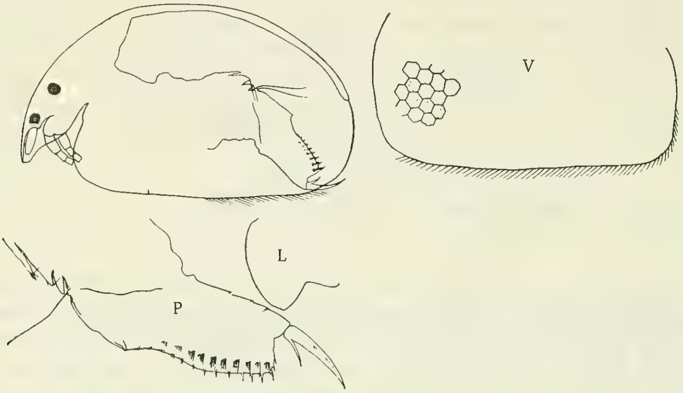

FIGURE 444. Alona cambouei, female, length 0.47 mm (Minindee Lakes, New South Wales, Australia, 29 September 1961, preparation 1279):

L – preparation 1538.

Female. Posterodorsal and posteroventral corner of valves rounded. Valve with a pattern of polygons with dots inside them. Rostrum blunt. Three connected main head pores. Setae of antennae: 0–0–3/0–1–3, spines 1–0–1/0–0–1. Plate of labrum rounded.

Postabdomen slightly tapering distally. Preanal corner distinct. Anal margin slightly concave. Anal denticles and groups of lateral setae present. Ventral margin with incisions with setae. Claws with a long basal spine. Legs typical for the genus. Outer branch of endite of leg I with 3 setae, including 2 equally long brushlike setae and a hook-shaped seta less than $^1/_3$ as long. Length 0.47 mm.

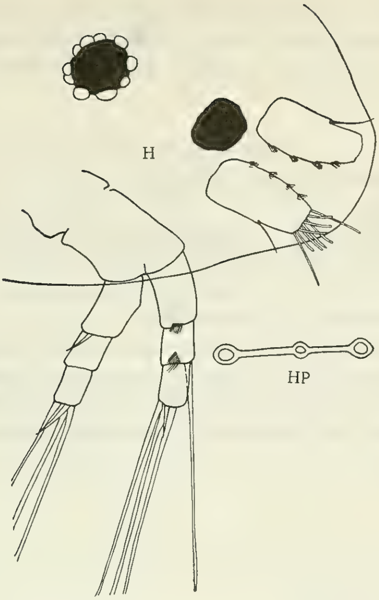

FIGURE 445. Alona cambouei, female (Minindee Lakes, New South Wales, Australia, 29 September 1961)

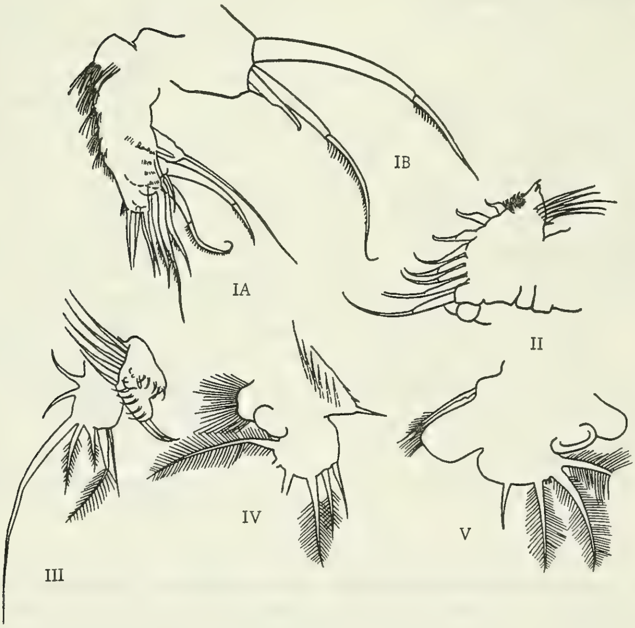

FIGURE 446. Legs of female of Alona cambouei (Minindee Lakes, New South Wales, Australia, 29 September 1961):

IA – left leg, inner side; IB – outer branch of endite of right leg I, inner side; II, III – left legs, inner side; IV – right leg, outer side; V – left leg, outer side.

Male. Postabdomen with 6 lateral groups of setae; anal denticles absent (replaced by short spinules). Length 0.35 mm.

Distribution. Central Asia and Mediterranean, Australian and Neotropical regions.

28. Alona inreticulata Shen Chia-jui et al., 1964
(Figures 447, 448)

Shen Chia-jui, Sung Ta-hsiang and Chen Kou-hsiao, 1964, pp. 215, 223–224, Figures 9–12.

Material. According to description.

Female. Valve without longitudinal lines or reticulation. Postabdomen with distinct preanal corner. Ten anal denticles, 6 proximal denticles small, 4 distal denticles large. Third denticle from the claw divided. Lateral setae in 7 groups. Length 0.36 mm.

(379)

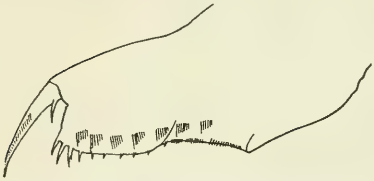

FIGURE 447. Postabdomen of female of Alona inreticulata (after Shen Chia-jui et al., 1964)

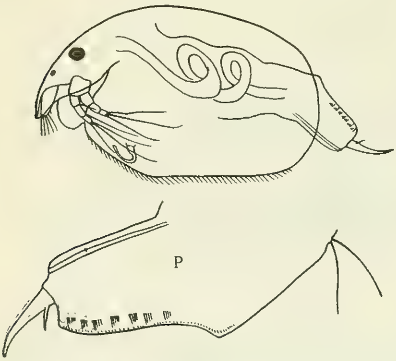

FIGURE 448. Alona inreticulata, male (after Shen Chia-jui et al., 1964)

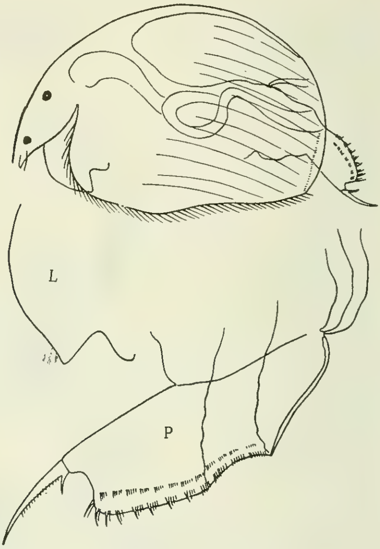

FIGURE 449. Alona fasciculata, female (after Daday, 1905)

Male. Valves with rounded posterodorsal and posteroventral corner. Antennules ending a short distance before apex of rostrum. Antennules with a sensory seta in distal third of anterior margin and with a short spine-shaped seta in distal quarter of posterior margin. Setae on antennae: 0–0–3/0–1–3. Postabdomen with small denticles on the dorsal margin.

Lateral setae in 7 groups. Preanal corner distinct. Ocellus smaller than eye, nearer to eye than to apex of rostrum. Length 0.34 mm.

Distribution. Peking.

29. **Alona fasciculata** Daday, 1905 (Figure 449)

Daday, 1905:177–178, Plate XI, Figures 9–11.

Material. According to description.

379 Female. Posterodorsal and posteroventral corner of valves rounded. Valve with lines and with small dots between the lines. Antennules ending slightly before apex of rostrum. Plate of labrum with convex anterior margin and pointed apex. Postabdomen narrowing distally. Preanal corner projecting. Eight anal denticles, 4 distal denticles accompanied by a seta, the others accompanied by several setae. Lateral setae in 8 groups. Anal margin with a double row of groups of setae. Claws with setae on the concave margin and with a basal spine. Ocellus nearer to apex of rostrum than to eye. Length 0.25 mm.

Male. Unknown.

Distribution. Paraguay.

30. **Alona guttata** Sars, 1862

Female. Valves with rounded posterodorsal and posteroventral corner. Head shield with rounded posterior margin. Three main head pores with a narrow connection between them (Frey, 1959, 1962a). Valve with lines. Antennules with terminal esthetascs of equal length. Antennae with a spine on proximal segment of exopodite and on both distal segments. Plate of labrum rounded. Dorsal margin of abdomen with 1–2 setae at the end. Postabdomen wide. Preanal corner projecting. Distal dorsal end of postabdomen pointed, projecting beyond base of claws. Anal margin slightly concave. Distal margin with 2 rows of 6–10 anal denticles. Postabdomen with indistinct lateral groups of setae (Frey, 1958). Claws sometimes with hairs on the concave side. Ocellus smaller than eye, situated halfway between eye and apex of rostrum. Length 0.4 mm.

Male. Posterodorsal and posteroventral corner rounded. Antennules with 2-segmented flagellum in distal part of anterior margin. Posterior margin of antennules distally with a sensory seta and a papilla. Postabdomen narrowing distally, without anal denticles. Lateral setae present. Vas deferens opening ventrally at base of claws. Claws without basal spine. Anterior side of endite of leg I with a brush of thick setae opposite the hook.

Biology. Lives in vegetation.

380 Key to Subspecies of A. guttata according to Females

1 (10). Valve without large round pits.
2 (9). Valve without spinules.
3 (8). Valve with longitudinal lines and polygons. Postabdomen with truncate distal margin.

4 (5). Antennules distinctly not reaching apex of rostrum . . . . 30a. A. **guttata guttata** Sars, 1862.
5 (4). Antennules almost reaching apex of rostrum.
6 (7). Posterior margin of labrum without setae . . . . 30b. A. **guttata parvula** Kurz, 1875.
7 (6). Posterior margin of labrum with 2 setae . . . . 30c. A. **guttata setigera** Brehm, 1931.
8 (3). Valves with pattern of polygons, without longitudinal lines. Postabdomen with slightly rounded distal dorsal corner . . . . 30d. A. **guttata reticulata** Hartmann, 1917.
9 (2). Ventral half of valves with spinules directed ventrally . . . . 30e. A. **guttata spinulosa** Linko, 1900.
10 (1). Valve with large rounded pits . . . . 30f. A. **guttata tuberculata** Kurz, 1875.

30a. **Alona guttata guttata** Sars, 1862 (Figures 450, 451)

Sars, 1862b:287–289 (guttata); Norman and Brady, 1867:29, Plate XVIII, Figure 6, Plate XXI, Figure 10 (Lynceus guttatus); Hellich, 1874:219 (anglica); Poggenpol', 1874:76, Plate XVII, Figures 12–16 (minuta syn.n.); Hellich, 1877:92–93, Figures 49, 40; Sars, 1891:13, 47 (parvula); 1901:51–52, Plate IX, Figures 3, 3a; Keilhack, 1905:143, Figure 2; Frey, 1959:35, Figures 22, 23; 1962a, Figures 22, 23; Šrámek-Hušek et al., 1962:333–335, Figures 123A, B, C (var. typica); Negrea, 1966a: 140–141 (guttata).

Material. One female from the Ivan'kovo and Rybinsk reservoirs; 2 females from Lake Seito in the Arkhangel'sk Region; 2 females from Lake Baikal; several females from Lake Kyla-Kol'. Two males from Shchugor River in the Komi ASSR. Preparations: MGU – females 438, 544, male 1677. ZIN – female 53867 (931), 53868 (2161), male 53869 (1679).

Female. Valves with longitudinal lines, with pattern of polygons posteriorly. Length 1.6 times the height. Antennules not reaching apex of rostrum. Leg I with 7 transverse rows of setules on anterior side of endite. Exopodite with a seta which is slightly longer than the longest seta on the outer branch of the endite. Epipodite with a long process. In the female from Lake Baikal, the main head pore is triple and the plate of the labrum broadly rounded (preparation 544).

Distribution. Cosmopolitan.

30b. **Alona guttata parvula** Kurz, 1875 (Figure 452)

Kurz, 1875:50, Plate II, Figure 8 (parvula); Lilljeborg, 1900:470, Plate LXVIII, Figures 18, 19, 24 (Lynceus guttatus var. parvula).

Female. Valves with weak longitudinal lines. Antennules almost reaching apex of rostrum. Eight anal denticles. Lateral setae absent. Claws with a short basal spine. Length to 0.4 mm.

Distribution. Central Europe, South Africa.

(381)

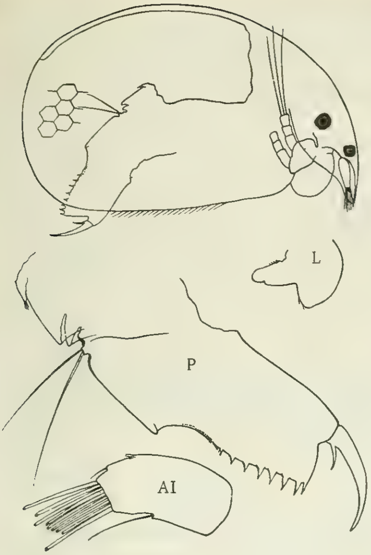

FIGURE 450. Alona guttata guttata, female, length 0.38 mm (Lake Seito, Arkhangel'sk Region, 24 July 1961, preparation 438):

L — 12 August 1962; P — 24 July 1961, preparation 438; AI — left antennule, lateral, 12 August 1961.

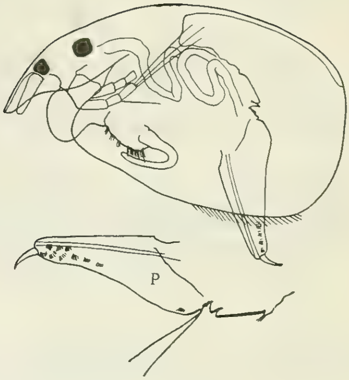

FIGURE 451. Alone guttata guttata, male, length 0.35 mm (Shchugor River, Komi ASSR, 6 September 1964, preparation 1677)

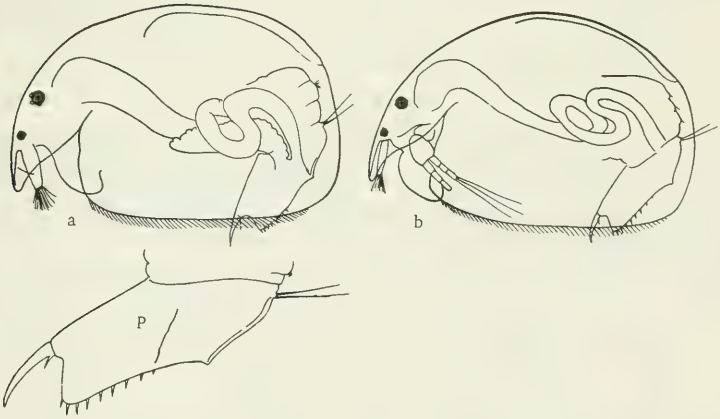

FIGURE 452. Alona guttata parvula, female:

a — after Kurz, 1875; b, P — after Sars, 1901.

30c. **Alona guttata setigera** Brehm, 1931 (Figure 453)

Brehm, 1931:499–500, Figures 7, 8, 9 (var. setigera).

Female. Antennules reaching apex of rostrum. Posterior margin of plate of labrum with 2 setae. Length 0.4 mm.
Distribution. New Zealand.

30d. **Alona guttata reticulata** Hartmann, 1917 (Figure 454)

Hartmann, 1917:93–94, Figures 14, 15, 16 (var. reticulata); Šrámek-Hušek et al., 1962:335 (var. reticulata).

Female. Valves high, with strongly convex dorsal margin. Length 1.2 times the height. Valve with pattern of polygons, without longitudinal lines. Postabdomen with several large denticles. Distal dorsal corner of postabdomen slightly rounded. Length to 0.33 mm.
Distribution. Austria.

30e. **Alona guttata spinulosa** Linko, 1900 (Figure 455)

Linko, 1900:12–13, Figures 3, 3a (var. spinulosa).

Female. Ventral half of valves with spinules directed ventrally.
382 Antennules almost reaching apex of rostrum. Postabdomen with 7–8 anal denticles and 2 rows of thin, lateral spinules in a row.
Distribution. Solovetskie Islands.

30f. **Alona guttata tuberculata** Kurz, 1875 (Figures 456, 457)

Kurz, 1875:51, Plate II, Figure 1 (tuberculata); Lilljeborg, 1900:470, Plate XLVIII, Figures 16, 17, 23 (Lynceus guttatus); Stingelin, 1913: 622, Figure 23 (var. tuberculata); Bening, 1941:297, 299 (var. tuberculata); Frey, 1959:35, Figures 24, 25; 1962a: Figures 24, 25; Šrámek-Hušek et al., 1962:335, Figures 123D–G (including drawing of male E–G); Herbst, 1962:86 (var. tuberculata).

Material. One female from the floodplain of Vychegda River and from Lake Lemty (Komi ASSR); several females from Kunashir Island. Preparations: MGU – female 1302. ZIN – female 53870 (1375).
Female. Valves and head shield pitted. Antennules not reaching apex of rostrum. Length to 0.4 mm.
Distribution. Europe, Columbia. USSR: Kunashir Island.

31. **Alona barbulata** Megard, 1967 (Figure 458)

Megard, 1967:37–57, Figures 9–19, Plate 2a, b.

Material. Holotype, British Museum No. 68. 1966. 3. 21. 5. Paratype male 68. 1966. 3. 21. 6.

Female. Head and dorsal margin of valve forming a curve. Posterior margin of valve slightly less than maximum height. Posteroventral corner broadly rounded, without denticles or spines. Valves without sculpture. Plate of labrum with rounded apex with several setae. Plate of labrum densely pubescent ventrally.

Postabdomen short, wide, slightly tapering at the end. Maximum width of postanal part about half as long as postabdomen. Anal margin slightly concave, almost as long as the postanal margin. Postanal and distal margin meeting at an angle of 80–90°. Six anal denticles, those near the anus serrated and accompanied by 2–4 setae. Anal margin with 2–3 groups of setae. Lateral setae in 7–9 groups, the middle setae the longest in the group. Ocellus smaller than eye, situated halfway between eye and apex of rostrum.

Basal spine of claw almost as long as basal width of claw. Antennules not reaching apex of rostrum. Anterior margin of rostrum blunt, posterior margin nearly pointed. Three main head pores with a narrow connection between them. Small pores situated lateral to the anterior main pore. Length to 0.43 mm.

Male. Valves with broadly rounded posteroventral corner. Margin of labrum densely pubescent. Postabdomen narrowing distally (resembling that of the male of Alona costata). Anal denticles 5–7. Lateral setae in 7–8 groups, the middle setae the longest in the group. Vas deferens opening on ventral side of postabdomen at base of claws. Claw with a basal group of setae. Antennules reaching apex of rostrum. Length 0.35 mm.

Distribution. Wyoming, Minnesota (U.S.A.).

Antennae and legs have not been described.

This species differs from A. guttata in that the preanal corner of the postabdomen is only slightly projecting, but it resembles the postabdomen of A. costata in this respect. A. barbulata differs from A. costata in that its small pores are rounded and indistinct, not plicate. The postabdomen of the male resembles that of the male of A. costata. In contrast to A. barbulata, however, the longest seta in the lateral groups is the distal seta in A. costata.

32. **Alona clathrata** Sars, 1888 (Figures 459, 460)

Sars, 1888:62–65, Plate 6, Figures 7–10.

Material. According to description.

Female. Postabdomen without lateral groups of setae. Posterodorsal corner distinct. Posteroventral corner rounded, without denticles. Rostrum pointed. Valves reticulate. Antennules almost reaching apex of rostrum. Postabdomen with obliquely truncate distal margin. Preanal corner projecting. Anal denticles small. Lateral setae absent. Claws with a basal spine. Ocellus almost as large as eye, situated slightly nearer to eye than to apex of rostrum. Length 0.38 mm.

Male. Height less than in the female. Postabdomen conical. Preanal corner indistinct. Vas deferens opening ventrally at base of claws. Claws without basal denticles. Length 0.28 mm.

Distribution. East Australia.

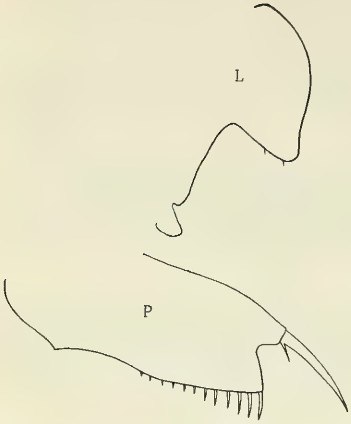

FIGURE 453. Alona guttata setigera, female (after Brehm, 1931)

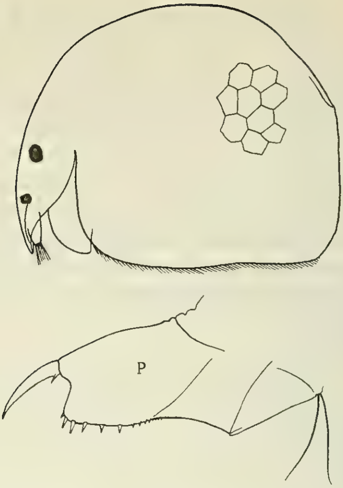

FIGURE 454. Alona guttata reticulata, female (after Hartmann, 1917)

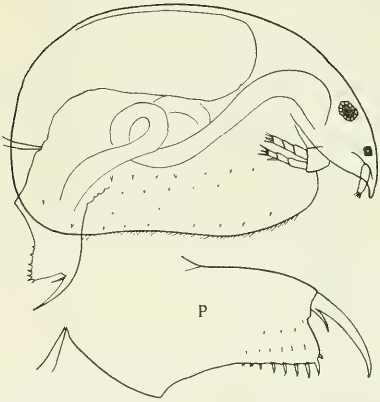

FIGURE 455. Alona guttata spinulosa, female (after Linko, 1900)

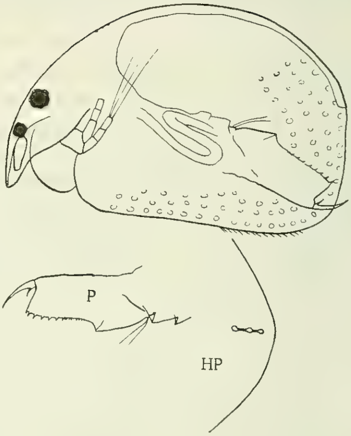

FIGURE 456. Alona guttata tuberculata, female, length 0.3 mm (Lake Lagunnoe, Kunashir Island, 1–10 July 1963, preparation 1302):

P – postabdomen; HP – after Frey, 1962a.

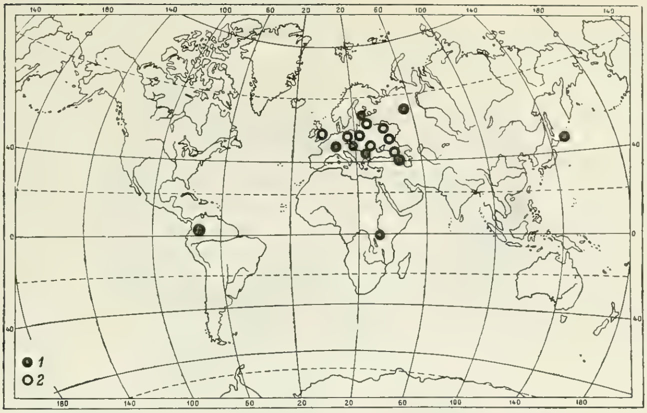

FIGURE 457. Distribution:

1 — Alona guttata tuberculata; 2 — A. protzi protzi.

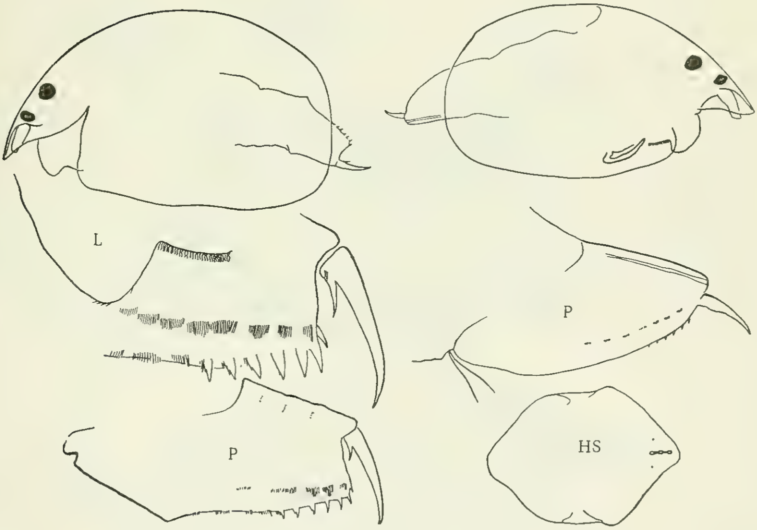

FIGURE 458. Alona barbulata, female (after Megard, 1967)

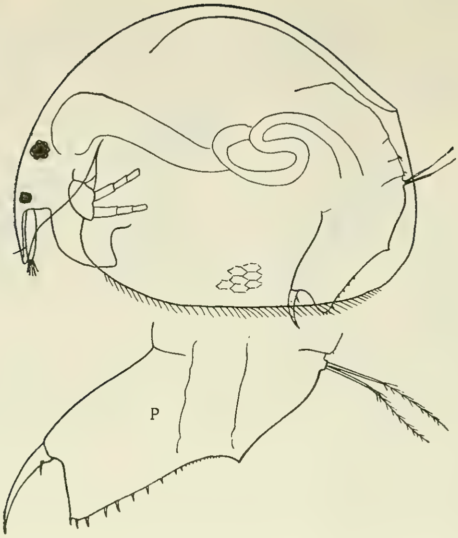

FIGURE 459. Alona clathrata, female
(after Sars, 1888)

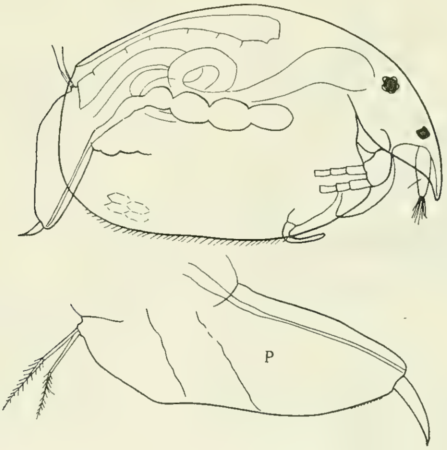

FIGURE 460. Alona clathrata, male
(after Sars, 1888)

33. **Alona protzi** Hartwig, 1900

Negrea, 1966a:142.

Material. According to description.

386 Female. Posterodorsal margin of valves rounded. Posteroventral corner rounded, with 3 denticles of equal length. Valve indistinctly reticulate, polygons with fine dots. Antennules twice as long as their basal width and ending at a distance of about the width of the eye before the apex of the rostrum. Two distal sensory papillae longer than the others. Setae on antennae: 0–0–3/1–1–3. Plate of labrum triangular, with pointed apex. Postabdomen with distinct preanal corner. Anal denticles 11–13. Basal spine of claw half as long as claw. Ocellus smaller than eye. Ratio between distance from eye to pigment spot and distance from pigment spot to rostral apex 7:10. Length 0.35 mm.

Male. Valve with 3 denticles on the posteroventral corner. Dorsal margin of postabdomen with only setae. Length 0.33 mm.

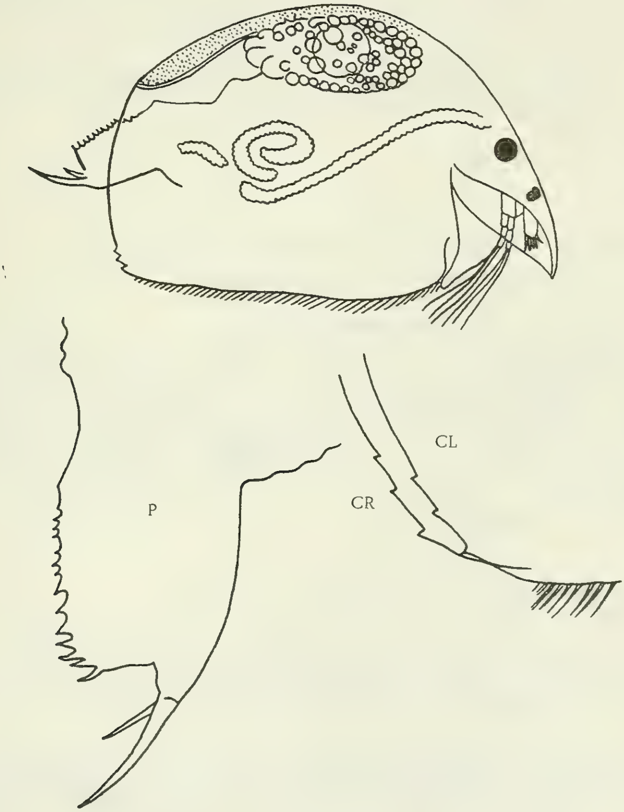

FIGURE 461. Alona protzi protzi, female (Olkhovitsa brook, Voronezh Region). Drawing by T.V.Sklyarova.

Key to Subspecies of A. protzi according to Females

1 (2). Postabdomen without lateral setae .... 33a. A. protzi protzi Hartwig, 1900.
2 (1). Postabdomen with lateral groups of setae .... 33b. A. protzi schiklejewi Brehm, 1933.

33a. Alona protzi protzi Hartwig, 1900 (Figures 457, 461)

Hartwig, 1900:228–230 (protzi); Keilhack, 1907:466, Figure 21 (protzi); Bening, 1941:317 (f. typica); Herbst, 1962:88, Figures 63a, b (protzi).

388 Female. Postabdomen without lateral setae.
Distribution. Europe.

33b. Alona protzi schiklejewi Brehm, 1933 (Figure 462)

Gurney, 1921:236–248, Figure 1 (protzi); Ramult, 1930a:337–339, Plates 27, 28, Figure 82 (protzi); Brehm, 1933a:718 (schiklejewi); Bening, 1941:317, Figure 131c (f. schiklejewi).

Female. Postabdomen with about 9 groups of lateral setae, setae in groups of equal length.
Distribution. Europe.

34. Alona archeroides Brehm, 1933 (Figure 463)

Brehm, 1933a:724–725, Figures 28, 29, 30.

Material. According to description.
Female. Posterodorsal and posteroventral corner of valves rounded. Rostrum blunt. Valves with 12 longitudinal lines. Antennules reaching apex of rostrum. Plate of labrum rounded. Postabdomen narrowing distally. Anal denticles 10–12. Six isolated lateral spines. Ocellus situated halfway between eye and apex of rostrum. Length 0.5 mm.
Male. Unknown.
Distribution. Sumatra, Java.

35. Alona karelica Stenroos, 1897 (Figures 464, 465)

Stenroos, 1897:52–53, Figures 5, 6; Weigold, 1911:23 (rectangula karelica); Herr, 1917:103–105, Figures 30–33; Bening, 1941:308–309, Figure 127; Herbst, 1962:88, Figure 66.

Material. According to description.
Female. Posterodorsal and posteroventral corner of valves rounded. Ventral margin of valves straight, with setae. Reticulation of valve consisting of rows of dots alternating with longitudinal grooves. Rostrum blunt. Antennules reaching apex of rostrum. Posterior margin of antennules with a sensory seta. Plate of labrum almost square. Dorsal end of

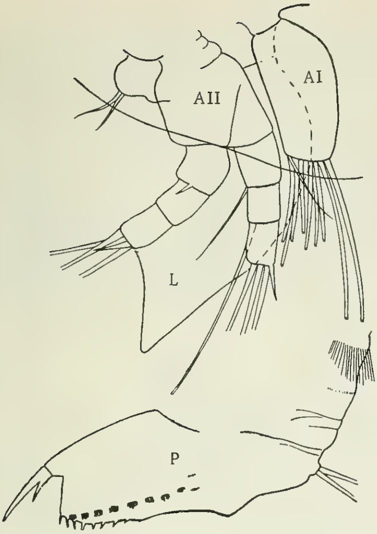

FIGURE 462. Alona protzi schiklejewi, female (after Gurney, 1921)

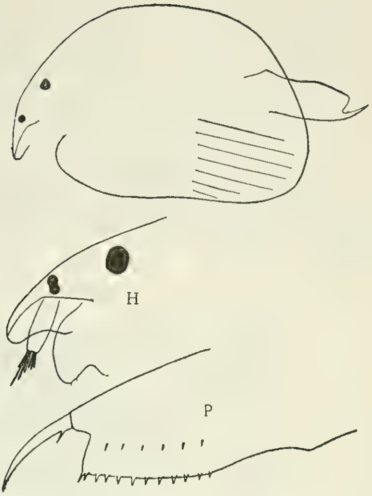

FIGURE 463. Alona archeroides, female (after Brehm, 1933b)

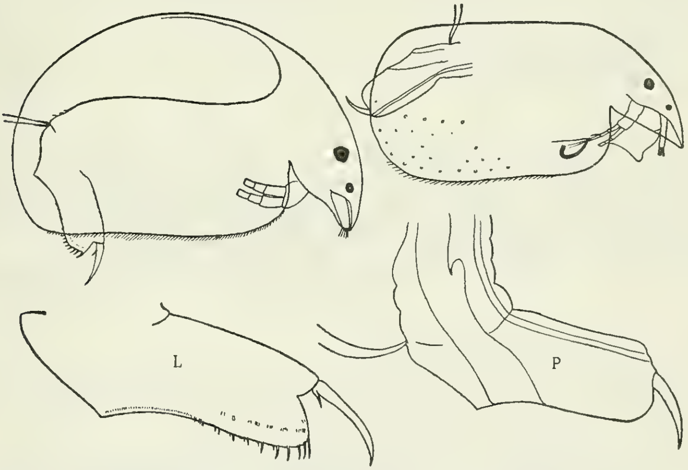

FIGURE 464. Alona karelica. Female – after Stenroos, 1897; male – after Herr, 1917.

abdomen with 3–4 setae. Postabdomen uniformly wide. Dorsal distal end projecting beyond base of claws. Anal margin slightly concave, with a row of setae laterally. Postanal margin with 8–10 denticles, further proximally several setae directed to the distal end. Several groups of setae laterally. Claws with a short basal spine. Preanal corner projecting, twice as near to the natatorial setae as to the end of the postabdomen. Ocellus situated halfway between eye and rostral apex. Length to 0.51 mm.

Male. Dorsal and ventral margin of valves straight, parallel. Posterodorsal and posteroventral corner rounded. Valves punctate. Antennules reaching apex of rostrum. Postabdomen with parallel dorsal and ventral margin.

(389)

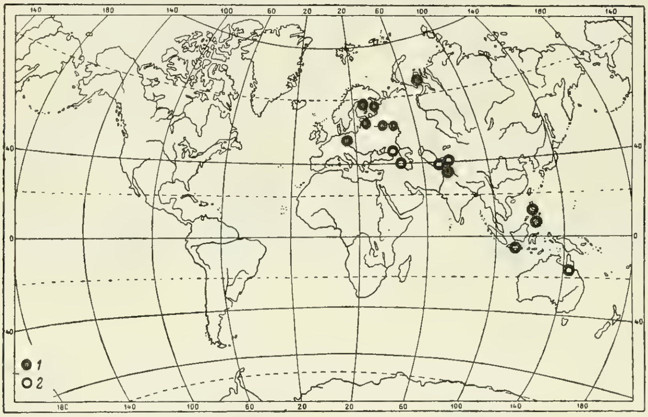

FIGURE 465. Distribution:

1 – Alona karelica; 2 – A. archeri.

According to Herr (1917), postabdomen with smooth dorsal margin without spinules or setae. Claw without basal spine. Preanal corner twice as near to the natatorial setae as to end of postabdomen. Vas deferens opening ventrally at base of claws. Length to 0.3 mm.

Distribution. Europe. Northwest of European USSR, Yamal, Pamir.

36. Alona subantarctica Ekman, 1908

Ekman, 1908:8, 9 (bukobensis var. subantarctica).

Material. According to description.

Female. According to Sars (1909), maximal height $^2/_3$ of length of body. Posterodorsal corner distinct, almost at level of apex of body. Rostrum blunt. Ventral margin of valves slightly convex anteriorly, then straight, with setae its whole length. Valve with 14–16 longitudinal lines, anastomosed in some places. Antennules almost reaching apex of rostrum. Plate of labrum wide, with slightly pointed apex. Postabdomen uniformly wide. Preanal corner distinct, only slightly projecting, situated slightly proximal to middle of postabdomen. Dorsal margin rounded distally. About 12 postanal denticles. Lateral spinules present. Claw with a basal denticle. Intestine forming loops, with a caecum. Ocellus larger than eye, situated slightly nearer to eye than to apex of rostrum. Length to 0.57 mm.

Male. Valve with indistinct longitudinal lines which are anastomosed in some places. Antennules reaching beyond apex of rostrum. Postabdomen without postanal denticles, with lateral denticles. Vas deferens opening at base of claws, ventral to them. Anal denticles in 7 groups
389 of 3–4 spinules, the distal spinule larger than the others in each group. An isolated spinule situated distal to the groups, about 3 groups of hairs proximal to the groups. Groups of lateral setae present. Length to 0.53 mm.

Distribution. Falkland Islands, South Georgia.

37. Alona archeri Sars, 1889 (Figures 465, 466)

Sars, 1888:59, Plate 6, Figures 1–4; Shikleev, 1929:25–27, Figures 17–19 (rectangula var. ornata); 1930b:342–343, Figures 8, 9 (rectangula var. ornata); Šrámek-Hušek et al., 1962:399 (intermedia var. ornata).

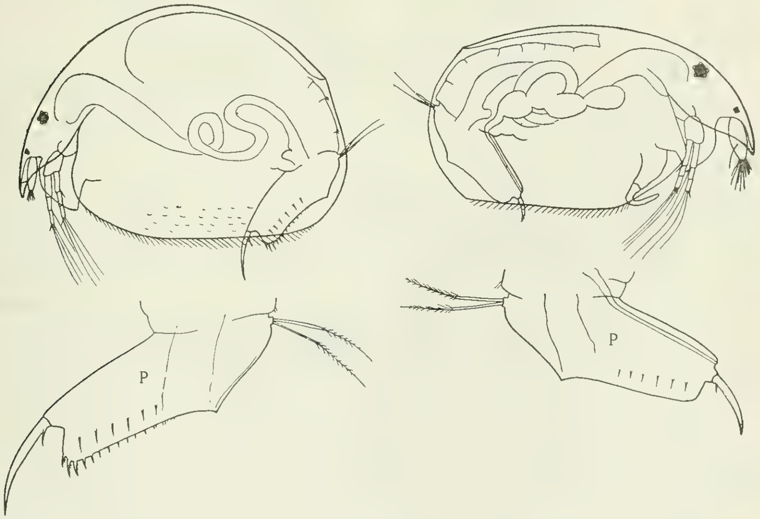

FIGURE 466. Alona archeri, female and male (after Sars, 1888)

390 Material. According to description.

Female. Valves with rounded posterodorsal and posteroventral corner. Ventral margin of valves almost straight. Rostrum pointed. Valves pitted. Antennule not reaching apex of rostrum, its anterior margin with a sensory seta. Setae on antennae: 0–0–3/0–1–3. Postabdomen with parallel margins. Preanal corner projecting. Distal anal denticles with small setae on the inner margin. Six thin spines laterally. Anal denticles forming small spinules proximally (Mukhamediev, 1960a, 1960b). Postabdomen with 6–8 large spines laterally. Anal denticles 12 (Brehm, 1933b); one seta very long in the lateral groups (Brehm, 1937). Claw with a basal spine. Anal margin with setae. Ocellus much smaller than eye. Intestine forming loops, with a caecum. Length to 0.5 mm.

Male. Body moderately high. Antennules projecting beyond apex of rostrum. Postabdomen without anal denticles. Isolated anal setae present. Preanal corner projecting. Claws with a basal spine. Vas deferens opening at base of claws, ventral to them. Length 0.34 mm.

Distribution. Central Asia, Indo-Malayan and Australian regions. USSR: Northern Caucasus, Central Asia.

38. Alona eximia Kiser, 1948 (Figure 467)

Kiser, 1948:315–316, Figures 1, 2, 3; Green, 1952:423–424, Figures 15–17.

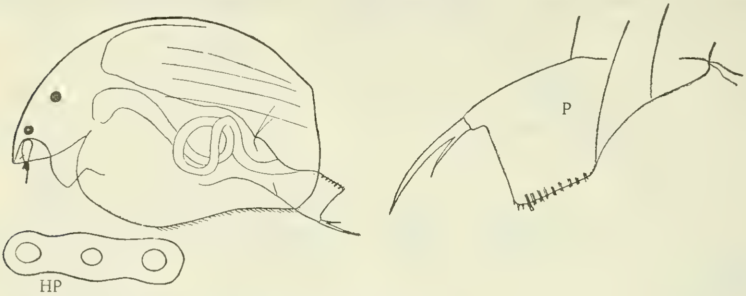

FIGURE 467. Alona eximia, female, left side: P – after Kiser, 1948; HP – after Green, 1952.

Material. According to description.

Female. Valve with longitudinal lines. Posterodorsal corner distinct. Posteroventral corner rounded, without denticles. Rostrum short, blunt. Three broadly connected main head pores (Green, 1952). Antennules ending slightly before apex of rostrum. Esthetascs slightly projecting beyond apex of rostrum. Most sensory papillae about $^1/_3$ as long as antennules; one papilla long. Sensory seta on lateral surface of antennule situated at about $^1/_3$ of length of antennule before the apex. Plate of labrum without denticles. Postabdomen wide distally, narrow in the anal area. Claw with a basal spine half as long as claw. Postanal denticles short. Nine–ten groups of setae laterally, projecting beyond dorsal margin apically.

Anal margin with groups of small setae (Green, 1952). Length to 0.4 mm.

Male. Unknown.

Distribution. East China, West Africa.

39. Alona pseudanodonta Brehm, 1933

Material. According to description.

Female. Maximum height in middle. Posterodorsal and posteroventral corner rounded. Antennules almost reaching apex of rostrum. Plate of labrum rounded. Postabdomen with anal denticles and lateral setae. Claw with a basal spine. Ocellus situated halfway between eye and apex of rostrum.

Male. Unknown.

Key to Subspecies of A. pseudanodonta

1 (2). Valve without tubercles . . . . 39a. **A. pseudanodonta pseudanodonta** Brehm, 1933.
2 (1). Valve with tubercles . . . . 39b. **A. pseudanodonta anodonta** Daday, 1905.

391 39a. **Alona pseudanodonta pseudanodonta** Brehm, 1933

Daday, 1910b:132 (rectangula var. africana part); Brehm, 1933b: 77–78.

Female. Valve without tubercles.

Distribution. Lake Nyasa, Philippines.

39b. **Alona pseudanodonta anodonta** Daday, 1905 (Figure 468)

Daday, 1905:175, Plate XI, Figures 5, 6 (anodonta); 1908b:209–210; 1910b:132, Plate 7, Figures 5, 6, 7 (rectangula var. africana part).

Female. Valve with rows of tubercles, granulate between the rows. Postabdomen slightly widened distally. Anal denticles up to 10, decreasing in size proximally. Lateral setae in 7–8 groups, distal seta the largest in each group. Anal margin with setae. Preanal corner distinct but not projecting. Claw with a basal spine. Ocellus situated halfway between eye and apex of rostrum. Length to 0.38 mm.

Distribution. Lake Nyasa, Paraguay.

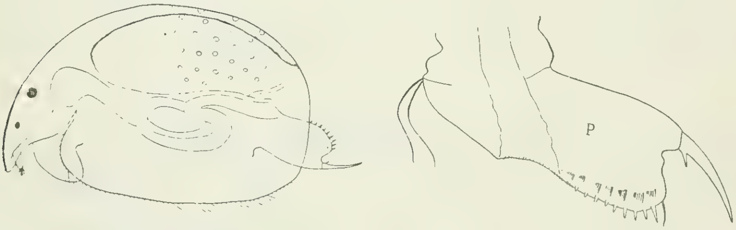

FIGURE 468. Alona pseudanodonta anodonta, female (after Daday, 1905)

40. Alona microtata Henry, 1922 (Figure 469)

Henry, 1922:41–42, Plate VIII, Figures 4, 4a.

Material. According to description.

Female. Posteroventral corner of valves rounded, without denticles. Valves reticulate anteriorly. Antennules not reaching apex of rostrum. Plate of labrum rounded. Postabdomen widened distally. Anal corner indistinct. Nine anal denticles, markedly decreasing in size proximally. Lateral groups of setae absent. Claws with a basal spine. Intestine forming loops, with a caecum. Ocellus smaller than eye, situated nearer to eye than to apex of rostrum. Length to 0.38 mm.

Male. Unknown.

Distribution. Southeast Australia.

41. Alona inkiti Schiklejew, 1929 (Figure 470)

Shikleev, 1929:25, Figures 15, 16; 1930b:342, Figures 6, 7.

Material. According to description.

Female. Posterodorsal and posteroventral corner rounded. Ventral margin of valve with setae continuing into short hairs on the rounded posteroventral corner. Valves smooth. Antennules almost reaching apex of rostrum. Postabdomen wide in postanal part, narrow in anal area. Anal spinules thin: 4 isolated spinules followed by 4 groups of 3, 3–5 and 7 setae. Anal indentation deep. Ocellus smaller than eye, situated nearer to eye than to apex of rostrum. Length 0.28 mm. Bening (1941) thinks that this is a doubtful species, possibly described after a malformed specimen. However, the existence of closely related species dispels these doubts to a large extent.

Male. Unknown.

Distribution. Northwest Caucasus.

42. Alona parva (Daday, 1905) (Figure 471)

Daday, 1905:186–187, Plate XI, Figures 20, 21 (Leydigia); Brehm, 1939b:184, Lám, 36, Figures 20, 21 (Alona sp.); Bergamin, 1931. MS Estudio systematico des Cladocera des aguas do municipio de S. Paulo. Thèse inaugural (Birgeia travassosi); 1939:86, Plate II, Figure 5 (Birgeia travassosi syn. n.); Goulden, 1966b:101–103, Plate 3, Figures 3, 4 (Leydigia).

393 Material. According to description.

Female. Valves with 12 longitudinal lines and granules between the lines. Posterodorsal and posteroventral corner broadly rounded. Head shield with rounded anterior and posterior margin. Main head pore triple. Antennules reaching apex of rostrum. Plate of labrum with pointed apex. Postabdomen widening distally. Ventral margin of postabdomen with 2–3 incisions with setae. Dorsal margin with anal setae, distal setae uniform, proximal setae passing into 10–12 groups of 4–6 setae; anal margin with hairs. Ten–twelve groups of setae laterally. Preanal corner distinct. Claws with a basal spine and with setae in proximal half of concave margin.

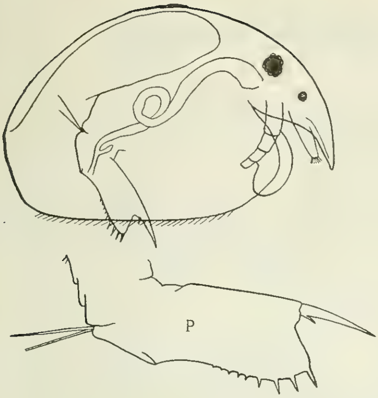

FIGURE 469. *Alona microtata*, female (after Henry, 1922)

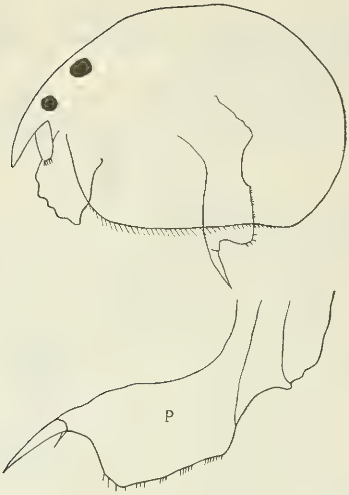

FIGURE 470. *Alona inkiti*, female (after Shikleev, 1929)

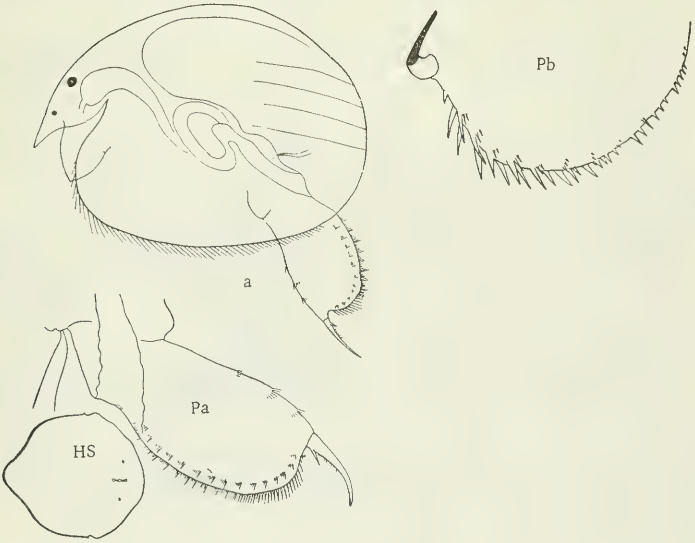

FIGURE 471. *Alona parva*, female:
a, Pa – after Daday, 1905; Pb, HS – after Goulden, 1966b.

Ocellus smaller than eye. Length to 0.6 mm. After examination of type material, Frey (1966) concluded that this species should be placed in the genus Alona.

Male. Unknown.

Distribution. Paraguay, Guatemala, São Paulo (Brazil).

43. Alona labrosa G. L. Vasiljeva and N. N. Smirnov, 1969 (Figures 472, 473)

Vasil'eva and Smirnov, 1969:191–193, Figures 4–2a, b, c.

Material. Nineteen females from Lake Baikal. One male and one juvenile male from the same locality. British Museum female 2105.

Holotype. MGU – female 2104.

Allotypes. MGU – male 2170, juvenile male 2171.

Paratype. ZIN – female 15845 (1842).

Female. Maximum height in the middle. Head shield passing into dorsal margin in a smooth curve. Valves with rounded posterodorsal and posteroventral corner. Posterior margin moderately convex. Ventral margin of valve slightly convex, with short setae. Valve without sculpture. Rostrum blunt. Three main head pores, with a narrow connection between them. Antennules not reaching apex of rostrum. Some esthetascs short, others long, the short ones reaching the anterior margin of the head shield, the long ones projecting beyond it. Setae on antennae: 0–0–3/0–1–3. Plate of labrum elongate, wedgelike. Anterior margin of plate of labrum convex, sometimes slightly depressed apically. Apex of plate of labrum forming a narrow angle with blunt end.

Postabdomen wide. Postanal margin convex, dorsal distal corner broadly rounded. Anal denticles small, few, tending to form groups. Claw with a basal spine.

Leg I with 7 transverse rows of seta on anterior side of endite. One of the setae on the outer branch of the endite short, hook-shaped. Endite of leg II with 8 hard setae. Exopodite of leg II with a short seta.

Leg III with square exopodite; epipodite without process. Endite with 2 groups of hard setae. The group distant from the gnathobase consists of 2 hard setae and a feathered seta proximal to them. The group of setae nearest the gnathobase is situated close to the sensilla. Endite with 5 soft setae. Gnathobase with filtering fan of 4 setae.

Leg IV (it could not be examined in detail) with an endite with 4 hard setae, one of them (distant from the gnathobase) strongly chitinized, the other setae feathered.

Leg V with oval exopodite with 4 setae. Endite lobed, with 2 setae. Epipodite with process; a lobed preepipodite present.

Ocellus almost as large as eye (not smaller), situated halfway between eye and apex of rostrum. Length 0.46 mm.

Male. Valve with straight dorsal margin. Posteroventral and posterodorsal corner rounded. Rostrum blunt. Postabdomen tapering distally. Ocellus situated nearer to apex of rostrum than to eye. Length 0.32 mm.

Juvenile male. Resembling the female, but with stepped ventral margin of postabdomen. Anal denticles present. Claw with a basal spine. Length 0.30 mm.

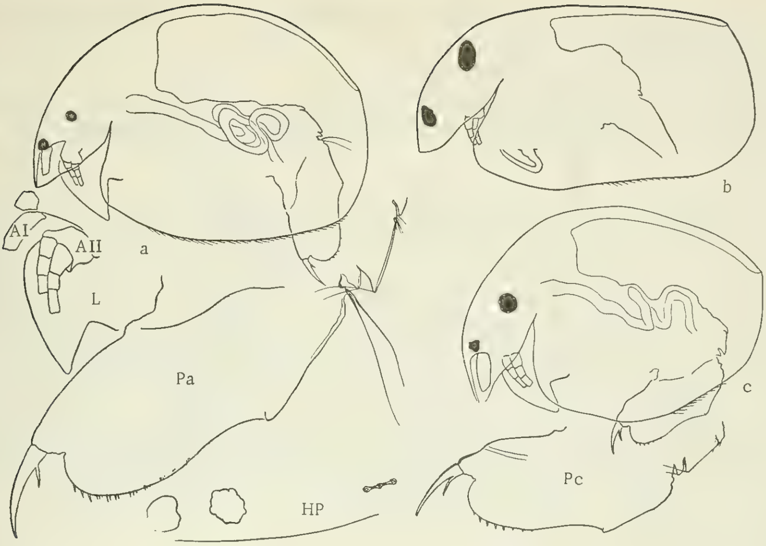

FIGURE 472. Alona labrosa (Lake Baikal, near the rivers Utulik-Murina):

a — female, length 0.46 mm, preparation 2104, 28 July 1964; Pa — its postabdomen; HP — head pores (distance between pores and eye shown); b — male, length 0.32 mm, preparation 2170; c — juvenile male, length 0.30 mm, preparation 2171; Pc — postabdomen.

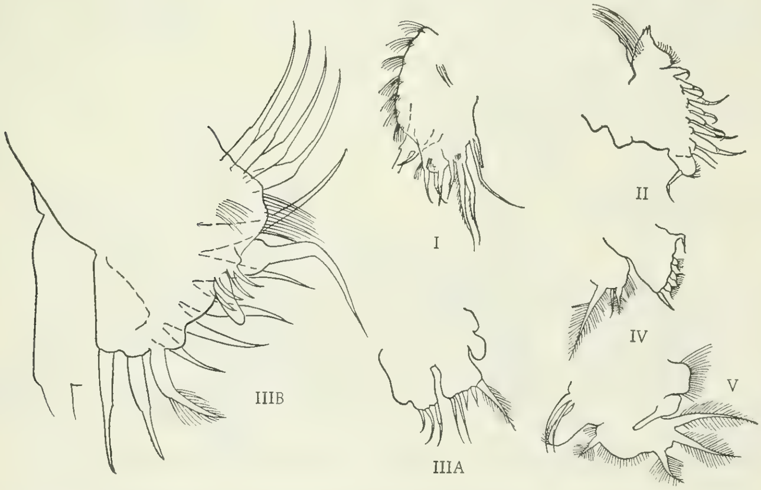

FIGURE 473. Legs of female of Alona labrosa (Baikal, near the rivers Utulik-Murina, 28 July 1964):

I — right leg, inner side; II, IIIA, V — left legs, outer side; IV — left leg, inner side; IIIB — endite and gnathobase of right leg.

Alona labrosa differs from related species in the elongate, wedgelike plate of the labrum.

Distribution. Lake Baikal.

Biology. Found at a depth of 1.7–12 m on stony and sandy bottom, from late June to late August. Males were found on 25 August 1965.

44. **Alona abbreviata** Sars, 1896 (Figure 474)

Sars, 1896b:40–42, Plate 6, Figures 5, 6; 1904b:635.

Material. According to description.

Female. Maximum height before the middle. Valve with longitudinal lines and indistinct reticulation posteriorly, with transverse lines in anteroventral part. Posterodorsal corner distinct, posteroventral corner rounded. Antennules almost reaching apex of rostrum. Plate of labrum 395 with a denticle on the anterior margin. Postabdomen with about 10 anal denticles and distinct preanal corner near middle of postabdomen. Claw with a basal spine. Ocellus smaller than eye. Length 0.37 mm.

Male. Unknown.

Distribution. Southeast Australia.

45. **Alona hardingi** Brehm, 1957 (Figure 475)

Harding, 1957b:78–79, Figures 29–38 (monacantha); Brehm, 1957: 230–238.

Material. According to description.

Female. Valve with 12 longitudinal lines with tubercles ventrally. Anterior margin of labrum with a small denticle. Postabdomen with irregularly distributed anal denticles and with 5 lateral groups of setae. Claw with a basal spine $^1/_3$ as long as claws.

Male. Unknown.

Distribution. Lake Tanganyika.

Species incertae sedis

Alona alluaudi Richard, 1898:440. Nomen nudum.

Alona angulata Birge, 1879:28–29, Plate II, Figure 16.

Alona bairdii King, 1853, 259, Plate VIIIA.

Alona barroisi Moniez, 1888:16 (A. barroisi).

Alona diaphana King, 1853:260, Plate VIII, C.

Description and drawings of King do not permit synonymization of this species.

Alona duodonta (Henry, 1922), Henry, 1922-49, Figures 1–4 (Alonella).

Alona glacialis Birge, 1879:30–31; Herrick, 1884:100, Plate G, Figures 2, 3.

Alona glacialis var. laevis Herrick, 1884:101.

Alona glacialis var. tuberculata Herrick, 1884:101, Plate G, Figures 4, 6, 7, 14.

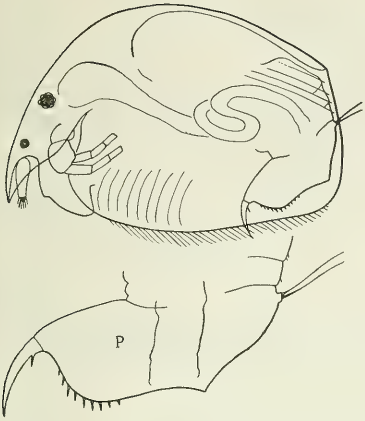

FIGURE 474. Alona abbreviata, female (after Sars, 1896b)

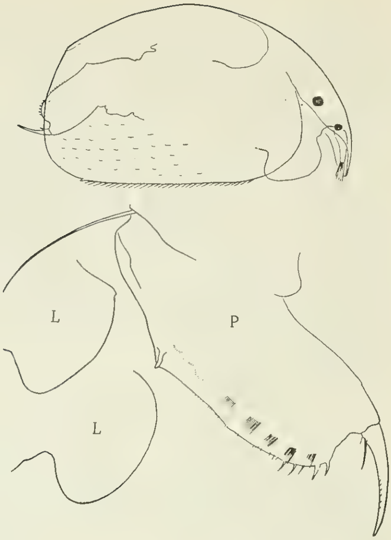

FIGURE 475. Alona hardingi, female (after Harding, 1957b)

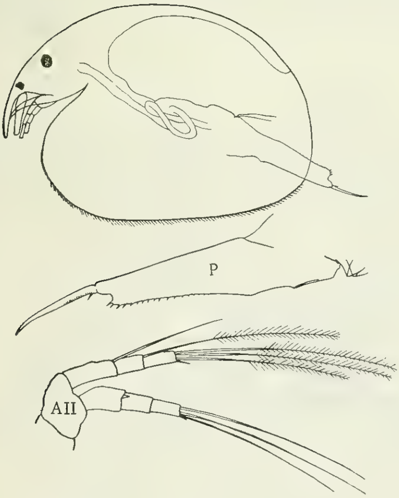

FIGURE 476. Kurzia latissima, female, length 0.53 mm (Gagra, preparation 829):

P — postabdomen of same specimen; AII — after Lilljeborg, 1900.

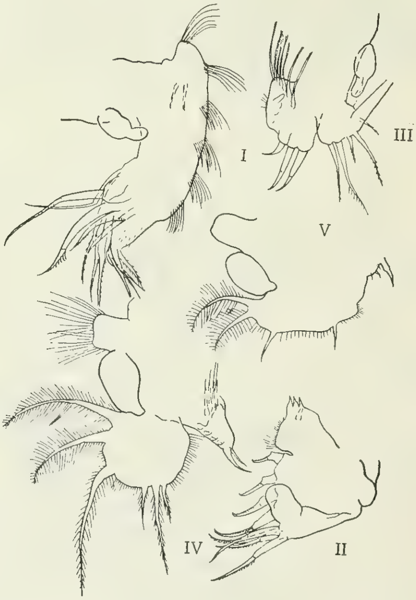

FIGURE 477. Legs of Kurzia latissima, female (pond of the Yakot' fish farm, 4 July 1967:

I, II, IV — right legs, outer side; III — right leg, inner side; V — left leg, inner side.

Alona inornata nalibokiana (Dybowski and Grochowski, 1895). Dybowski and Grochowski, 1895:150 (Coronatella inornata var. nalibokiana). Nomen nudum.

Alona lacustris Daday, 1888:99–100, Plate II, Figures 19, 20.

Alona ladacensis Brehm, 1936b:295–296, Figures 4A–E.

Alona mascula King, 1853:261–262, Plate VIII E.

Alona modesta Herrick, 1884:97, Plate H, Figure 3, Plate Q Figure 4.

Alona moniezi Richard, 1888b:46–47 (without drawings). Moniez, 1889:347. According to a preparation in the British Museum, No. 68 Norman Collection 1911. 11. 8. M 4136, this is a form of Alona rectangula.

Alona ovata Baird, 1950:133, Plate XVI, Figure 2.

Alona porrecta Birge, 1879:29–30, Plate I, Figure 16; Herrick, 1884:99.

Alona quadrangularis var. delaticiana Dybowski and Grochowski, 1895:150. Nomen nudum.

Alona rectangula f. angulata Weigold, 1911:98. Nomen nudum.

Alona similis (Dybowski and Grochowski, 1898a):52–53, Figure 9 (Coronatella similis). Nomen nudum.

Alona socors (O. F. Müller, 1785):78, Plate XI, Figures 1, 2, 3 (Lynceus).

Alona świteziana Dybowski and Grochowski, 1895:150. Nomen nudum.

Alona tuberculata Hudendorff, 1876. Hudendorff, 1876:54–55, Plate II, Figure 6.

Alona verrucosa Lutz, 1879:44, Nomen nudum (Johnson, 1956a:200).

Alona Weinecki Studer, 1878:108–109, Plate III, Figure 3; Rühe, 1921:53–55, Figures 18c, d; Lofthouse, 1967:142.

13. Genus Kurzia Dybowski and Grochowski, 1894

Hellich, 1874:219 (Alona part); Kurz, 1874:40 (Alonopsis part); Sars, 1891:47 (Alonella part); Dybowski and Grochowski, 1894:380; 1895:150; Sars, 1901:85 (Pseudalona); Daday, 1910b:136 (Pseudalona); Bening, 1941:261; Šrámek-Hušek et al., 1962:328; Herbst, 1962:84.

Body oval. Dorsal margin of valves convex, ventral margin convex anteriorly, concave in posterior half. Rostrum long, directed ventrally. Head shield with rounded posterior margin. Main head pores in the median line of head shield connected, small pores lateral to them (Frey, 1959), distance from small pores to posterior margin of head shield shorter than distance between pores. Antennules narrow, elongate. Setae on antennae 0–0–0/1–1–3. Five pairs of legs. Postabdomen narrow, with distal dorsal end. Claw with a basal spine and row of small setae on the concave margin. Vas deferens opening ventrally at base of claws. Intestine forming loops, with a caecum. Ocellus smaller than eye, situated nearer to eye than to apex of rostrum.

397 Key to Species of the Genus Kurzia according to Females

1 (2). Antennules almost reaching apex of rostrum . . . . 1. K. latissima (Kurz, 1875).
2 (1). Antennules reaching to middle of rostrum . . . . 2. K. longirostris (Daday, 1898).

Key to Species of the Genus Kurzia according to Males

1 (2). Antennules and antennae projecting beyond apex of rostrum . . . . 1. K. latissima.
2 (1). Antennules and antennae not reaching apex of rostrum . . . . 2. K. longirostris.

1. **Kurzia latissima** (Kurz, 1875) (Figures 476–479)

Hellich, 1874:219 (Alona tenuirostris); Kurz, 1875:46–47, Plate II, Figures 13, 14, 15 (Alonopsis); Hudendorff, 1876:5–56, Plate II, Figures 7a, 7b (Alona angusticaudata); Hellich, 1877:89, Figure 46 (Alona); Birge, 1879:32, Plate I, Figures 14, 15 (Alonopsis media); Herrick, 1884:86, Plate E, Figure 8, Plate G, Figures 1, 9 (Alonopsis), 86–87, Plate E, Figure 9 (Alonopsis media); Matile, 1890:43, Figure 32 (Alona); Sars, 1891:47 (Alonella); Stingelin, 1895:242–243, Plate VII, Figure 31 (Alonopsis); Lilljeborg, 1900:442–445, Plate LXVI, Figures 1–7; Sars, 1901:85–87, Plate XII, Figures 2, 2a, 2b (Pseudalona); Daday, 1905:183–184, Plate XI, Figure 17 (Pseudalona); Bening, 1941:261–263, Figure 108; Frey, 1959:35, Figures 12, 13, 14; 1962a, Figures 12, 13, 14; Šrámek:Hušek et al., 1962:329, Figure 121; Herbst, 1962:84, Figure 59.

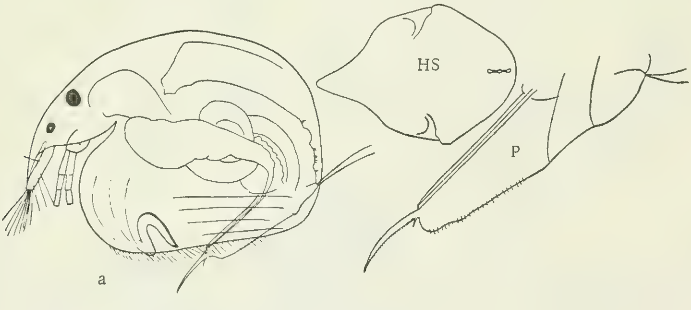

FIGURE 478. Kurzia latissima, male:

a – after Kurz, 1875; HS – after Frey, 1962a; P – after Birge, 1879.

Material. Numerous females from ponds on the Yakot' fish farm near Moscow; one female from Gagra. Preparations: MGU – female 829, ephippial female 2212, male 2214. ZIN – female 2207, male 2213.

Female. Head and valves forming the semicircular dorsal margin. Posterodorsal corner of valves rounded, situated slightly below the maximum height of valve; posteroventral corner rounded, without denticles. Dorsal keel present; head keel absent, eyes therefore situated on the margin. Antennules with flagellum in the middle. Ventral margin of head S-shaped. Valves with lines.

According to Frey (1959) head shield with long rostrum and rounded posterior margin. Ratio between distance from posterior pore to posterior margin of head shield and distance between pores less than 1. Antennules almost reaching apex of rostrum. Esthetascs situated on distal end of antennules. Setae on antennae: 0–0–1/1–1–3. Antennae with spines on proximal segment of exopodite and on both distal segments. Ventral margin of labrum convex, sometimes slightly serrated. Postabdomen narrowing distally. Preanal corner not projecting. Dorsal margin with 2 rows of 10–12 anal denticles which increase in size distally. Lateral surface with a row of groups of setae. Claw with a basal spine and a row of setae on the concave margin, a larger seta distal to the middle. Ocellus situated nearer to eye than to apex of rostrum. Intestine forming loops, with a caecum. Five pairs of legs, according to the illustration of Herrick (1884, Plate G, Figure 9). Leg I with rows of setules on anterior side. One seta of leg III very long. Length to 0.6 mm.

(398)

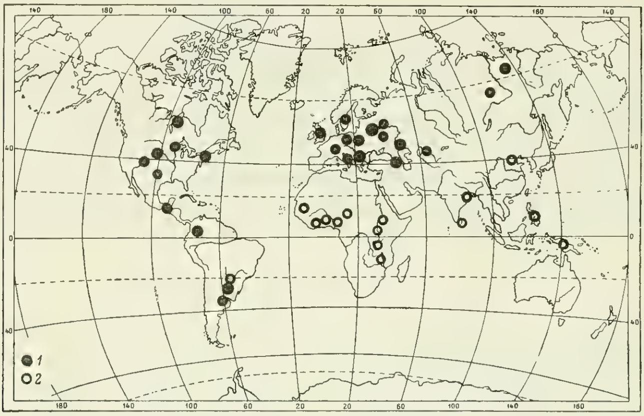

FIGURE 479. Distribution:

1 – Kurzia latissima; 2 – K. longirostris.

Male. Posterodorsal and posteroventral corner rounded. Head shield with long rostrum (but shorter than in female) and with rounded posterior margin. Antennules projecting distinctly beyond apex of rostrum. Anterior margin with a 2-segmented flagellum distally, posterior margin with a sensory seta. Distal margin with esthetascs of different length. Post-
398 abdomen tapering distally. Anal denticles of postabdomen forming groups. Claw with one basal spine. Intestine forming loops, with a caecum. Ocellus smaller than eye, situated slightly nearer to eye than to apex of rostrum. Length to 0.4 mm.

Distribution. Holarctic and Neotropical regions. European USSR, to mouth of the Syrdar'ya River in the East.

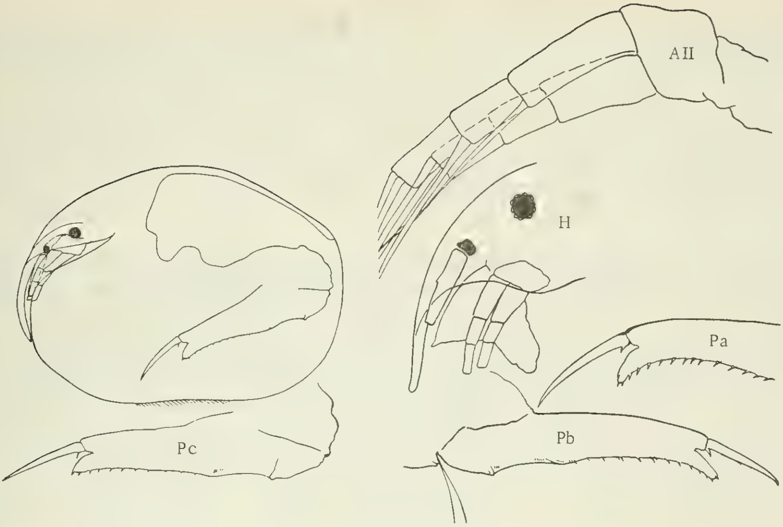

FIGURE 480. Kurzia longirostris, female, length 0.42 mm:

AII – inner view from the left side; AII, H, Pb – Lake Jor, Nile, 8 February 1964; Pa – White Nile near Alyab, 27 January 1964, preparation 1301, left side; Pc – White Nile, near Tonga, preparation 985.

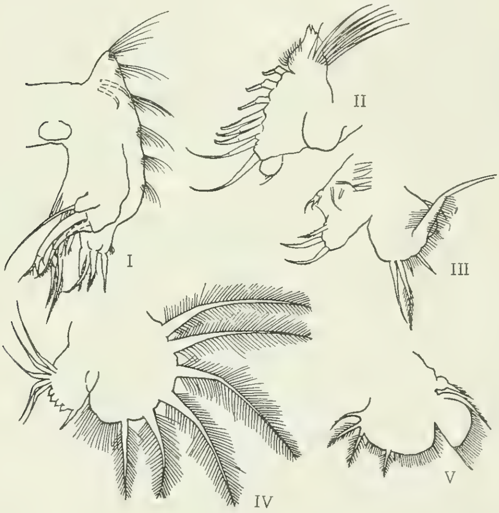

FIGURE 481. Legs of female of Kurzia longirostris (Lake Jor, White Nile, 8 February 1964):

I, V – right legs, outer side; II – left leg, inner side; III – right leg, inner side; IV – left leg, outer side.

2. Kurzia longirostris (Daday, 1898) (Figures 479–482)

Daday, 1898:34, Figure 14 (Alona); Sars, 1901:87–88, Plate XII, Figures 3, 3a, 3b (Pseudalona); Daday, 1901a:39–40, Figure 17 (Alona macrohyncha); 1905:184–185, Plate XI, Figure 18 (Pseudalona); 1910b:136, Plate 7, Figures 23, 24 (Pseudalona); Bär, 1924:111–112 (Pseudalona); Brehm, 1933b:30–40, Figures 10, 11 (Pseudalona); Gauthier, 1937:94–95, Plate VIIA (Pseudalona); Brehm, 1951c:84, 85, 91, 92 (Pseudalona); Harding, 1957b; 73, Figure 15.

Material. Numerous females from the White Nile. Preparations: MGU – female 985, 1301, male 334. ZIN – female 2055. Ph – female 2052.

Female. Posterodorsal and posteroventral corner rounded. Rostrum long, slightly curved posteriorly. Apex of rostrum in median line of body. Valve with longitudinal lines and fine dots. Antennules reaching middle of rostrum, esthetascs projecting beyond apex of rostrum. Antennae not reaching apex of rostrum. Plate of labrum with pointed apex, punctate. Postabdomen slightly concave dorsally, with a deep indentation on the distal side. Preanal corner not projecting. Anal denticles 12–20. Distal dorsal corner of postabdomen produced in old females. Claws with a basal spine. Intestine forming 1.5 loops. Ocellus smaller than eye, twice as near to eye as to apex of rostrum.

According to Green (1952), postabdomen with lateral groups of setae. Length about 0.42 mm. Leg I with 6 transverse rows of setules on the anterior side. Outer branch of endite of leg I with 2 hook-shaped setae and a short seta half as long. On the long setae the brush setules on one side consist of 2 long proximal setules, so that the other part of the seta appears as a small flagellum (Figure 129). Leg II with 8 scraping seta, 6 of them pectinate, the other 2 long and thinner. Exopodite of leg III with 5 setae posteriorly, 2 long anterior setae, followed by 2 small setae and a large fifth seta which is long and curved dorsally. Leg IV with large rounded exopodite with 6 feathered setae. Leg V relatively small.

Male. (Described for the first time.) Valves with rounded posterodorsal and posteroventral corner. Rostrum pointed. Antennules almost reaching apex of rostrum. Antennae not reaching apex of rostrum. Postabdomen tapering distally. Several groups of lateral setae. Anal margin
400 slightly convex. Preanal corner not projecting. Vas deferens opening at base of claws, ventral to them. Claw with a small basal spine. Ocellus smaller than eye, situated slightly nearer to eye than to apex of rostrum. Length 0.46 mm.

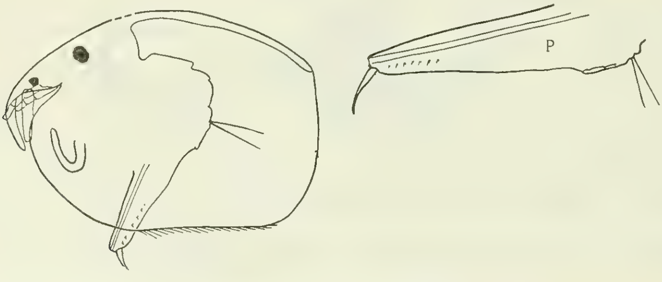

FIGURE 482. Kurzia longirostris, male, length 0.46 mm (White Nile, Alyab, 27 January 1964, preparation 334).

Distribution. Ethiopian, Indo-Malayan, Neotropical regions, northeast China, New Guinea.

Biology. Lives in vegetation.

Species incertae sedis

Kurzia yunnanensis Shen, Tai and Chiang, 1966:36, 37, 42, Figures 24–26.

Female. Valve high. Dorsal keel present. Posterior margin of valves straight, about half of height. Rostrum short. Antennules not reaching apex of rostrum; esthetascs projecting beyond apex of rostrum. Setae on antennae: 0–0–1/1–1–3.

Postabdomen tapering distally. Anal denticles 13–15. About 10 groups of lateral setae. Claw with a long basal spine and setae on the concave margin.

Plate of labrum rounded. Intestine forming 1.5 loops, with a caecum. Ocellus smaller than eye. Two parthenogenetic embryos. Length to 0.45 mm.

Male. Unknown.

Distribution. Yunnan (China).

This species differs markedly from the other two species of the genus Kurzia in having a very high body and a blunt rostrum, a relatively short postabdomen, and a long basal spine on the claw.

The structure of the head pores and legs has not been described and the taxonomic position of this form can therefore not be determined with certainty.

Nomen nudum

Kurzia nalibokiana Dybowski and Grochowski, 1895:150.

Kurzia polonica Dybowski and Grochowski, 1894:380.

14. Genus Acroperus Baird, 1843, emend. N. N. Smirnov, 1966

Jurine, 1820 (Monoculus, part); Baird, 1834 (Lynceus, part); 1843: 91 (subgenus Acroperus); 1850:129, Sars, 1862b:289 (Alonopsis); Kurz, 1875:44 (Acroperus), 45 (Alonopsis); Hellich, 1877:78 (Acroperus), 80–81 (Alonopsis); Herrick, 1884:81 (subgenus Acroperus), 85 (genus Alonopsis); Stingelin, 1895:239 (Acroperus), 241 (Alonopsis); Lilljeborg, 1900:416–418 (Acroperus), 432–433 (Alonopsis); Bening, 1941:251 (Acroperus), 255–256 (Alonopsis); Šrámek-Hušek et al., 1962:321 (Acroperus), 324 (Alonopsis); Herbst, 1962:82 (Acroperus, Alonopsis); Smirnov, 1966a:113–136 (Acroperus, Alonopsis).

Type species: Acroperus harpae Baird, 1835.

Body oval, strongly compressed laterally. Valve with longitudinal lines. Three connected main head pores; small pores situated a considerable distance from them. Antennules of female not reaching beyond apex of rostrum. Setae on antennae: 0–0–3/0(1)–1–3.

Postabdomen with anal denticles which are very small in some species. Lateral margin of postabdomen with a row of setae arranged in groups. Claws with a tubercle with setae on the dorsal side. Claw with one basal spine. Intestine forming loops, with a caecum. Ocellus smaller than eye. Vas deferens opening ventrally.

401 Six pairs of legs. Leg I with rows of setae on anterior side of endite. Outer branch of endite of leg I with 3 setae including 2 long, brushlike setae and a hook-shaped seta which is half as long. Exopodite of leg I with a seta as long as the longest seta on the outer branch of the endite. Leg II with 8 hook-shaped, hard setae on the endite. Leg III with a square exopodite. Leg IV with a rounded exopodite on which seta 4 is longest. Leg V with slightly bifid exopodite with 4 setae, one seta on the anterior side directed anteriorly, and 3 setae on the posterior side. Leg VI in the form of a small lobe.

Male with modified postabdomen and leg I.

The genus Alonopsis Sars, 1862, has been united with the genus Acroperus because of the close resemblance of the morphology of the legs and head pores. Moreover, Acroperus elongatus (Alonopsis elongata Sars) is phylogenetically a predecessor of Acroperus harpae. This is proved not only by morphological considerations (e.g., development of a keel and reduction of the anal denticles in Acroperus harpae), but also by the geographical distribution of the two species, i.e., the restricted distribution of Acroperus elongatus and the wide distribution of Acroperus harpae.

Sars (1862b) established the genus Alonopsis for Alona elongata Sars, 1862a. Sars did not give a diagnosis of the genus. The reasons for the establishment of the genus Alonopsis are as follows: "The other form, Alona elongata (Lynceus macrurus Leydig), is closely related to the genus Acroperus Baird, in a number of characters, especially in the structure of the first pair of antennae and the postabdomen, and in the structure of the valves, but it differs distinctly in the absence of the high keel on the head which is characteristic for Acroperus and in the absence of a distinct rostrum. On the other hand, the form of the valve proves that this species belongs either to Alona or to another genus for which I propose the name Alonopsis" (Sars, 1962b).

Lilljeborg (1900:433) published a detailed description of the genus Alonopsis: "Body of female more or less compressed laterally or oblong or rounded oval, with rounded corners of the valves. Head convex dorsally, without keel. Valves often with more or less distinct oblique lines. Depression behind the head absent. Eye and ocellus of normal position. Antennules of varying structure. Antennae with 5 natatorial setae on the endopodite, 8 such setae altogether. Maxillae with 3 nonsegmented pubescent setae, one of them shorter than the others. Five or six pairs of legs; pair VI small, indistinct; leg V large, the preceding pairs resembling those of the genera Acroperus and Lynceus. Postabdomen of female more or less prolonged; posterodorsal margin with 2 rows of spinules, a row of scalelike groups of very small setae. Claws of female with a basal spine; concave margin of claws with 1–2 large and several small spinules. Intestine forming an almost double loop, with a more or less long process in the posterior part of the body. The vasa deferentia open before or below the postabdominal process which bears the claws."

The genus Lynceus as defined by Lilljeborg corresponds to the genus Alona Baird, 1843. Lilljeborg also placed Alonopsis latissima Kurz, 1874 in the genus Alonopsis while most later authors place this species in the genus Kurzia Dybowski and Grochowski, 1894. Alonopsis elongata Sars, 1862, the type species of Alonopsis, was originally described as Alona elongata Sars, 1862a. Sars (1862b) also stressed the close affinities of this species with the genus Acroperus Baird, 1843. As he was convinced that the legs of the species of Alonopsis are identical with those of Acroperus and Lynceus (Alona), Lilljeborg (1900; also other authors) never described the legs of Alonopsis ambigua. The morphology of A. ambigua later proved that this species belongs to the genus Tretocephala.

Alonopsis titi Harding, 1955 resembles Alonopsis elongata in its general habitus and in the form of the postabdomen and claws; however, it differs in the formula of the setae on the antennae: 0–0–3/0–1–3. The armature of the postabdomen distinctly resembles that of Acroperus.

The data given above for Acroperus elongatus apply also to this species, especially because the formula of the setae on the antennae is the same as in Acroperus.

Alonopsis lomnicki Grochmalicki, 1915, closely resembles Oxyurella Dybowski and Grochowski in its general form, the form of the postabdomen, the anal spinules, the claws, and their basal spine. However, this species should be studied further because many characters which may determine its systematic position are not known.

Characters of Acroperus elongatus (type species of the genus Alonopsis) and Tretocephala ambigua:

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	Acroperus elongatus	Tretocephala ambigua
Posteroventral corner of valve	With denticles	Without denticles
Tubercle with setae on base of claws	Present	Absent
Antennules, ratio of length: width	About 2.6	About 1.8
Esthetascs	Of different length	Of equal length
Main head pore	Triple	Double
Small head pores	Distant from the main pore	Near the main pore
Integument of posterior part of abdomen	With supporting elements	Without supporting elements
Exopodite of leg III	One of the setae is not more than twice as long as the longest of the other setae. This seta extends not farther than the setae of leg IV	One of the setae is three times as long as the longest of the other setae. This seta extends to the setae of leg IV
Exopodite of leg IV	Rounded, with setae of different length	Rectangular, with setae of equal length
Leg V	Exopodite slightly bifid, endite narrow	Exopodite entire, endite wide
Epipodites of legs IV and V	With long processes reaching to opposite margin of exopodite	With short processes

The resemblance between Acroperus elongatus and Tretocephala ambigua concerns only the form of the body and postabdomen.

On the other hand, the characters of Alonopsis elongata resemble those of Acroperus. According to the drawings published, Lilljeborg knew the structure of the legs of Acroperus harpae and Biapertura affinis. Our considerations are based on our data on the morphology (including that of the legs) of Acroperus harpae, A. alonoides, Alona quadrangularis, Biapertura affinis, Alona costata and A. rectangula. The data show that the legs of Alonopsis elongata resemble those of Acroperus harpae (type species of the genus Acroperus, Figures 506 and 486). On the other hand, the legs of Tretocephala ambigua are of the same type as those of Alona quadrangularis (Figures 610 and 383).

The close relation between Alonopsis elongata and Acroperus is proved by the following characters: form of postabdomen, of the claw and the basal spine, the presence of a tubercle with setae on the base of the claws, the form of the antennules, the structure of the head pores, the presence of supporting elements in the posterior part of the abdomen, the structure of the legs (indistinguishable from those of Acroperus).

Alonopsis elongata differs from Acroperus in the absence of a keel on the head and of a dorsal keel, the presence of anal denticles on the postabdomen, the presence of setae on the proximal segment of the exopodite of the antennae, and the presence of striation between the lines on the valve (Figure 8).

However, the genus Acroperus contains forms with a different degree of development of the keel and even with a weakly developed keel (Acroperus alonoides); a keel is also present in some species of the genus Camptocercus Baird, 1843, but it is reduced in other species of this genus. The armature of the postabdomen, the sculpture of the valve and also the number of setae on the antennae may vary in some genera of Chydoridae.

These considerations justify the transfer of Alonopsis elongata to the genus Acroperus as Acroperus elongatus (Sars, 1862b). It is pertinent to quote the original description of Acroperus by Baird (1843:91, as a subgenus): "valves harplike, ending ventrally on the anterior margin in a more or less blunt apex directed anteriorly; antennae long." Baird referred to the ventral margin as anterior margin. The description of Baird does not contradict the transfer to Acroperus.

Sars (1862b) stressed the resemblance between Alonopsis elongata and Acroperus in the structure of the antennules and postabdomen. We can add some other characters: the resemblance of the legs, the skeletal formations in the posterior part of the abdomen, and the head pores. The only reason for the establishment of the genus Alonopsis is the form of the valves of Alonopsis elongata.

However, this argument is less important than those which suggest that Alonopsis elongata should be placed in the genus Acroperus.

Finally, the genus Alonopsis becomes unnecessary after the transfer of the type species Alonopsis elongata to the genus Acroperus.

403 Key to Species of the Genus Acroperus according to Females

1 (12). Head with a keel.
2 (11). Head keel well developed.
3 (6). Antennules not reaching apex of rostrum.
4 (5). Height at least 64% of length .... 1. **A. harpae** (Baird, 1834).
5 (4). Height at most 56% of length ...... 2. **A. angustatus** Sars, 1863.
6 (3). Antennules reaching apex of rostrum or projecting beyond it.
7 (10). Antennule reaching apex of rostrum.
8 (9). Height about 65% of length .... 3. **A. avirostris** Henry, 1919.
9 (8). Height less than 58% of length ... 4. **A. neglectus** Lilljeborg, 1900.
10 (7). Antennules projecting beyond apex of rostrum .... 5. **A. sinuatus** Henry, 1919.
11 (2). Head keel weakly developed .... 6. **A. alonoides** Hudendorff, 1876.
12 (1). Head without keel.
13 (14). Anal denticles large .... 7. **A. elongatus** (Sars, 1862).
14 (13). Anal denticles very small .... 8. **A. titi** (Harding, 1955).

Key to Species of Known Males of the Genus Acroperus

1 (2). Head keel present .... 1. **A. harpae**.
2 (1). Head keel absent.
3 (6). Dorsal distal corner of postabdomen projecting.
4 (5). Posteroventral corner of valves without denticles. . .4. **A. neglectus**.
5 (4). Posteroventral corner of valves with denticles . . . .6. **A. alonoides**.
6 (3). In adult males, dorsal distal corner of postabdomen not projecting, postabdomen therefore tapering gradually to the claws .... 7. **A. elongatus**.

1. **Acroperus harpae** (Baird, 1834) (Figures 483–490)

Jurine, 1820:154–156, Plate 16, Figures 1, 2 (Monoculus striatus); Baird, 1834:100, Plate II, Figure 17 (Lynceus); Edwards, 1840:387–388 (Lynceus striatus); Koch, 1841, No. 36, 10 (leucocephalus); Baird, 1843:91–92, Plate III, Figure 7; 1850:129, Plate XVI, Figure 5; Lilljeborg, 1853:88, Plate VII, Figure 5 (striatus ex parte); Leydig, 1860:216–217, Plate VIII, Figure 58 (Lynceus striatus); 218–219, Plate IX, Figures, 64, 65 (Lynceus leucocephalus); Schoedler, 1862: 24, Plate I, Figures 11–16 (leucocephalus); 1863:30, Plate I, Figure II (leucocephalus); 32 (striatus); Norman and Brady, 1867:20, Plate XXI, Figure 1 (Lynceus); P. E. Müller, 1867:167–168, Plate III, Figures 15–17, Plate IV, Figure 26 (leucocephalus), 169–170, Plate II, Figure 21, Plate III, Figure 19 (cavirostris); Herrick, 1884:106 (Alonella striat); Daday, 1888:102, Figures 35, 36 (transylvanicus); Stingelin, 1895:239–240, Plate VI, Figure 28 (leucocephalus); Lilljeborg, 1900: 418–425, Plate LXIII, Figures 14–24, Plate LXIV, Figures 1–10; Stingelin, 1906:326–327, Plate 13, Figures 1, 2, 6, 11; Keilhack, 1907:455–461; Langhans, 1911:46 (bairdi syn.n.); Dumitriu, 1934:436 (subsp. harpae); Bening, 1941:254 (harpae harpae); Frey, 1959:34, Figures 5–7; 1962a: Figures 5–7; Šrámek-Hušek et al., 1962:322, Figure 118; Herbst, 1962:82, Figure 57; Negrea, 1966a:139–140.

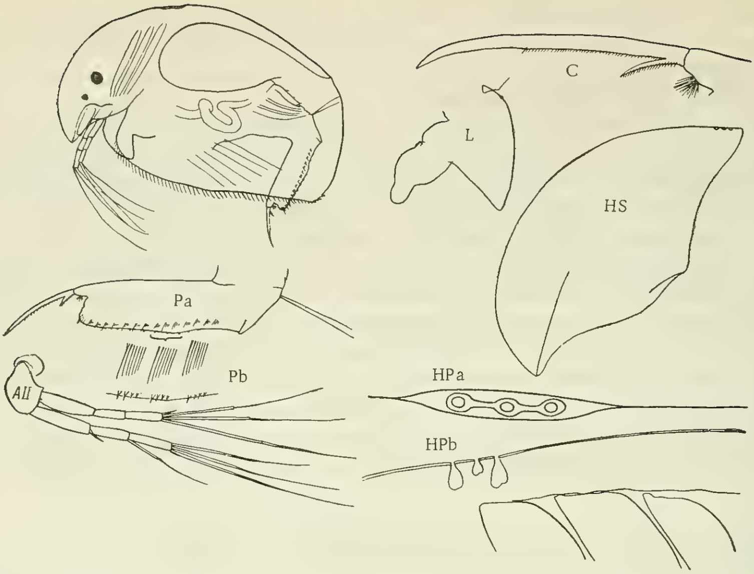

FIGURE 483. Acroperus harpae, female, length 0.68 mm (Rybinsk Reservoir, 13 June 1961):

Pa — preparation 22; Pb — part of armature of postabdomen, high magnification; L — Rybinsk Reservoir, Bor Timonino, 13 September 1963; HS — after Frey, 1962a; HPa — main head pores and keel, dorsal (Rybinsk Reservoir, Borok, 21 July 1965); HPb — cavities of main head pores, filled with a 10% solution of bromcresol purple after short exposure in life.

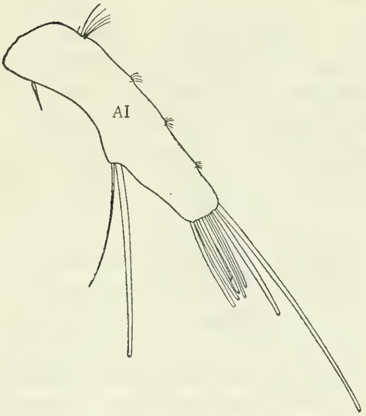

FIGURE 484. Antennules of female of Acroperus harpae (Rybinsk Reservoir, 13 June 1961)

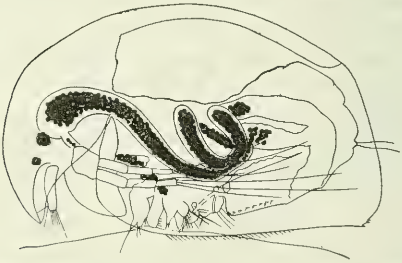

FIGURE 485. Acroperus harpae. Female feeding on the substrate. Detritus before mouth shown (Rybinsk Reservoir).

Material. Numerous females from the Rybinsk, Cherepovets and Kama reservoirs, Sutka River (tributary of the Rybinsk Reservoir), Komi ASSR, Sredne-Velinskii pond in the Perm Region, lakes in the Aktyubinsk and Dzhambul regions, lakes Sary-Chelek and Kyla-Kol' in southern Kirghizia, lakes in Chita Region, Amur basin, Turkey; several females from lakes in the Altai and in New South Wales; 8 females from the Kara-Su River at the confluence with the Zeravshan River; one female from the Frolikh Inlet in the northern part of Lake Baikal; several males from Shchugor River in the Komi ASSR and from Turkey. Preparations: MGU – female 1517, 22, 10, 1489, 206, malformed female 437, male 1516, juvenile male 1252. ZIN – female 53859 (1356), 53860 (813), male 1521, juvenile male 1251. Ph – female 1304, male 1514.

(405)

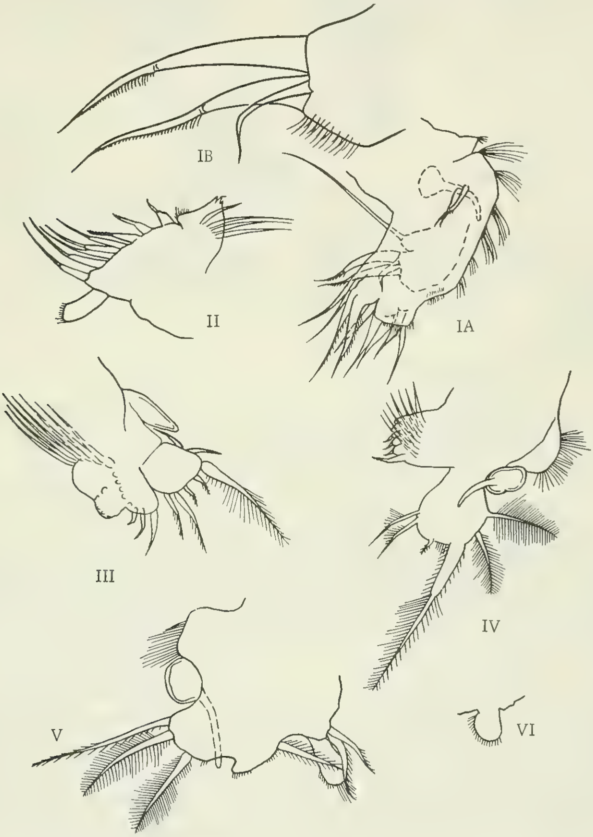

FIGURE 486. Legs of female of Acroperus harpae, left side (Bor Timonino, 13 June 1961):

IA, II, V – inner side; IB – outer lobe of endite of leg I, inner side; III, IV, VI – outer side.

Female. Maximum height slightly before middle of body. Ratio of height:length 64 to 67%, varying little with age (Werner, 1924).

Posterodorsal corner of valves only slightly lower than highest point of dorsal margin. Posteroventral corner of valves sometimes with 3–5 denticles. Valves with diagonal lines which are never anastomosed (Frey, 1958). Head shield with 3 connected main pores; lateral pores situated before anterior main pore (Frey, 1958, 1959, 1962a). Main pores situated on crest of keel which is therefore slightly wider at this point. Antennules not reaching apex of rostrum. Anterior margin of antennule with incisions with setae. Distal half of posterior margin with a long papilla and a smaller sensory seta, proximal half with a small seta; distal margin bearing the other esthetascs, one of them longer than the others. Proximal segment of exopodite of antennae and both distal segments with spines. Proximal segment of endopodite with a longer spine, second segment with a short seta. Plate of labrum triangular, with convex anterior margin and blunt apex.

(406)

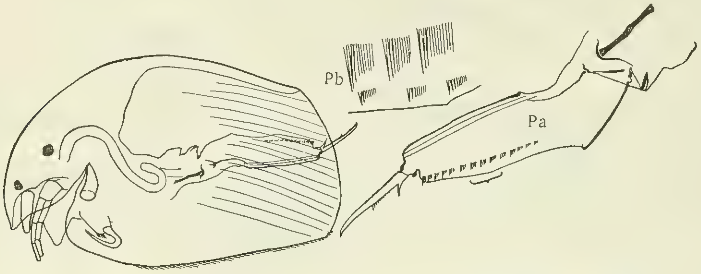

FIGURE 487. Acroperus harpae, male, length 0.58 mm (Shchugor River, Komi ASSR, 24 August 1958, preparation 1516):

Pb — part of armature of postabdomen, high magnification.

405 Dorsal margin of postabdomen with groups of 4–6 very small spinules, the distal spinule larger than the others in each group. Distal group of lateral setae on postabdomen larger than the other groups. Claws with a row of setae on the dorsal proximal margin. Distal seta larger than the others.

Legs typical for the genus. Outer branch of endite of leg I with 3 setae, 2 long brushlike setae and a hook-shaped seta which is half as long. Leg IV with a round exopodite on which seta 6 is the shortest and seta 7 the longest (more than twice as long as width of exopodite). Exopodite of leg V partly divided into 2 lobes. Seta 1 of exopodite directed anteriorly toward the lobed endite. Length (material from the Rybinsk Reservoir, May 1960) 0.4 (1st stage) to 0.81 mm, minimum length of gravid females (3rd stage) 0.61 mm.

Baird (1834:91–92) gave the following description of Acroperus harpae: "Valves resembling a harp, with longitudinal ridges like strings of a harp, rounded posteriorly, with indentations anteriorly and ending in an apex directed anteriorly; 4 antennae, almost as long as the valve, each

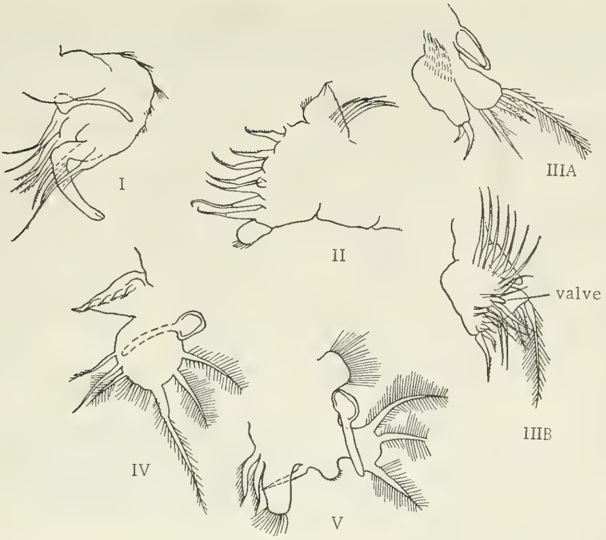

FIGURE 488. Legs of male of Acroperus harpae (Turkey, Uludag, September 1940):

I, II – right legs, outer side; IIIA, V – left legs, outer side; IIIB, IV – right leg, inner side.

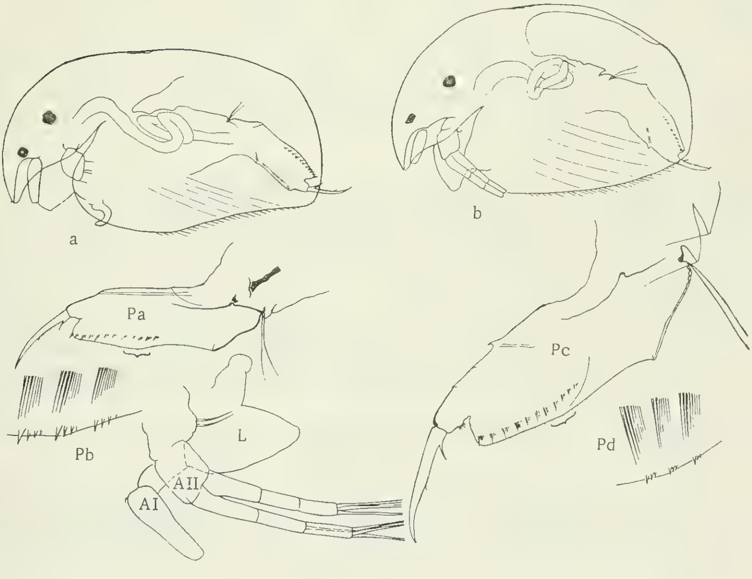

FIGURE 489. Acroperus harpae (Turkey, Uludag, September 1940):

a – juvenile male, length 0.5 mm, preparation 653; Pa – its postabdomen; AI, AII, L – left side; b – juvenile male, length 0.47 mm, preparation 1253; Pc – postabdomen; Pb, Pd – part of armature of postabdomen, high magnification.

consisting of 3 segments and ending in 3 long, straight setae; valves smooth, except at the anterior margin where they have an incision and bear setae. Postabdomen serrated, ending in 2 thick setae; head rounded, rostrum blunt."

The presence of a head keel and a dorsal keel is shown in the drawing of Baird (Figure 17, Plate II).

Male. Valves with rounded posterodorsal and posteroventral corner. Antennules reaching apex of rostrum. Anterior margin of antennules with a 2-segmented flagellum distally, posterior margin with 2 sensory papillae and a seta; other sensory papillae on the distal margin. Postabdomen slightly tapering distally. Groups of setae on lateral margin less developed than in the female. Claws with a basal denticle. Vas deferens opening ventrally near base of claws. Length to 0.58 mm.

In the juvenile male, the vas deferens opens far from the base of the claws.

Distribution. Holarctic, Ethiopian, Indo-Malayan, Neotropical regions. USSR: ubiquitous (no collections were made in Siberia).

Biology. Monocyclic at vegetation periods of 4.5 months; dicyclic at longer vegetation periods, and if the water does not freeze, secondarily dicyclic (Vereshchagin, 1912c).

2. Acroperus angustatus Sars, 1863 (Figures 490, 491, 492)

Sars, 1863:217, P. E. Müller, 1867:169, Plate III, Figure 18, Plate IV, Figure 27– Stingelin, 1895:240–241, Plate VII, Figure 29; Lilljeborg, 1900:429–432, Plate LXIV, Figures 22–27, Plate LXV, Figures 1–4; Keilhack, 1907:455–461; Uéno, 1937:206, Figure 5; Bening, 1941:254–255, Figure 105 (harpae angustatus); Negrea, 1966a:140 ("angustatus").

Material. Several females from Denmark, many females from the Karelian Isthmus. Preparations: MGU – female 951, 1240. ZIN – female 53855 (684). Ph – female 1216. British Museum 65 M 4143 Norman Collection.

Female. Maximum height of body less than 58% (55–56%) of length. Rostrum short, blunt. Dorsal margin almost straight, posterodorsal corner therefore almost at level of maximum height. Posteroventral corner rounded, with small denticles. Valves with diagonal lines. Antennules not reaching apex of rostrum.

Postabdomen with nearly parallel dorsal and ventral margin. Preanal corner distinct. About 16 groups of lateral setae. Claws curved only at the distal end. Concave side of claw with a row of setae, the distal seta larger.

Ocellus smaller than eye, situated nearer to eye than to apex of rostrum. Length 0.78 mm.

Male. Posteroventral corner of valves rounded, with small denticles. Posterodorsal corner distinct. Valves with lines. Antennules projecting distinctly beyond apex of rostrum. Head keel not developed. Plate of labrum rounded. Postabdomen with nearly parallel dorsal and ventral margin. Lateral groups of setae present. Preanal corner distinct but not pointed. Claws with a row of setae on the concave side. These setae

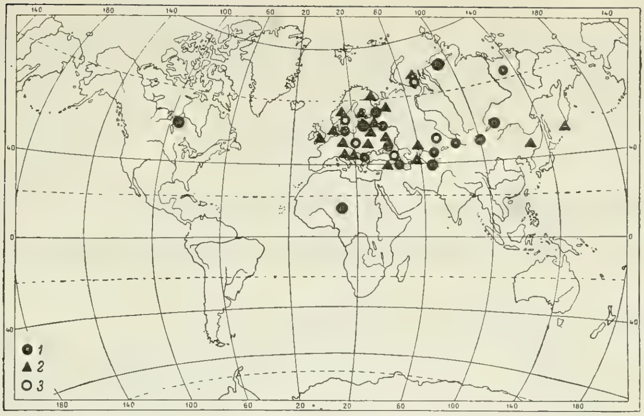

FIGURE 490. Distribution:

1 — Acroperus harpae s.str. (reliable data); 2 — A. angustatus; 3 — A. neglectus.

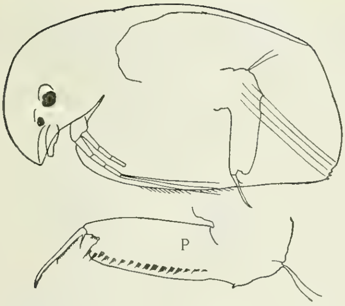

FIGURE 491. Acroperus angustatus, female, length 0.78 mm (Denmark, pond, 6 June 1904, preparation 1240)

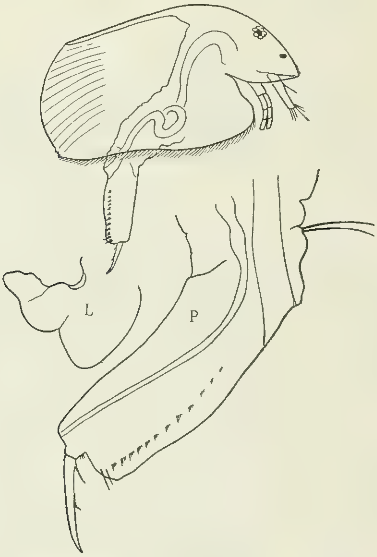

FIGURE 492. Acroperus angustatus, male (after Lilljeborg, 1900)

increase in length distally, the row ending in a spinule in the middle of the concave side of the claw. Intestine forming loops. Ocellus situated nearer to apex of rostrum than to eye. Vas deferens opening ventrally in middle of claw. Length to 1 mm.

Distribution. Palearctic.

409 3. Acroperus avirostris Henry, 1919 (Figure 493)

Henry, 1919:469–470, Plate XL, Figure 34; 1922:39, Plate VI, Figures 2, 2a.

Material. According to description.

Female. Maximum height more than half the length, before the middle. Posteroventral corner of valves with 2 denticles. Posterodorsal corner rounded. Valves with lines. Antennules reaching to apex of rostrum. Esthetascs projecting beyond apex of rostrum. Antennae with 3 setae and a spine on distal segment of exopodite and 3 setae on distal segment of endopodite. Plate of labrum triangular. Postabdomen with distinct preanal corner. Lateral setae in about 11 groups, the distal seta longer than the others in each group. Claw situated on a process of the postabdomen, straight, with curved apex, with a basal spine and a spinule in the middle of the concave side; a row of setae proximal to the spinule in the middle. Ocellus smaller than eye. Length to 0.68 mm.

Male. Unknown.

Distribution. Australia.

4. Acroperus neglectus Lilljeborg, 1900 (Figures 490, 494)

Lilljeborg, 1900:425–428, Plate LXIV, Figures 11–21; Stingelin, 1906:327, Plate 13, Figure 15 (harpae neglectus); Bening, 1941:254–255, Figure 105 (harpae neglectus); Negrea, 1966a:140.

Material. According to description.

Female. Maximum height of body in about the middle, usually less than 58% of length. Rostrum short, blunt. Dorsal margin of valves slightly convex; posterodorsal corner therefore only slightly lower than highest point of dorsal margin. Posteroventral corner of valve with denticles. Valves with longitudinal lines. Antennules reaching to apex of rostrum. Plate of labrum triangular, with convex anterior margin and blunt apex.

Postabdomen with parallel dorsal and ventral margin. Distal dorsal corner projecting, rounded. Preanal corner distinct but not strongly projecting. Lateral setae in about 14 groups. Claws straight, with curved apex, with a row of setae on the concave side, the distal seta larger. Intestine forming loops. Ocellus smaller than eye. Length to 0.78 mm.

Male. Valves with rounded posterodorsal and posteroventral corner. Valves with longitudinal lines. Antennules projecting beyond apex of rostrum. Posterior margin of antennules with 2 sensory papillae in contrast to the female. Head keel not developed.

Postabdomen slightly tapering distally. Preanal corner distinct. Lateral setae in about 13 groups. Claws with setae on the concave side,

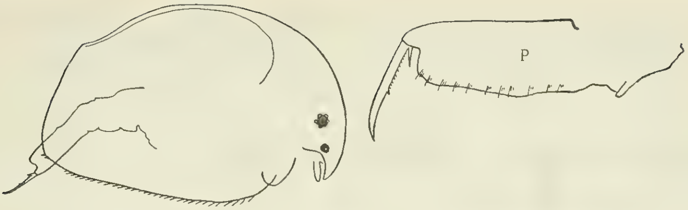

FIGURE 493. Acroperus avirostris, female (after Henry, 1919)

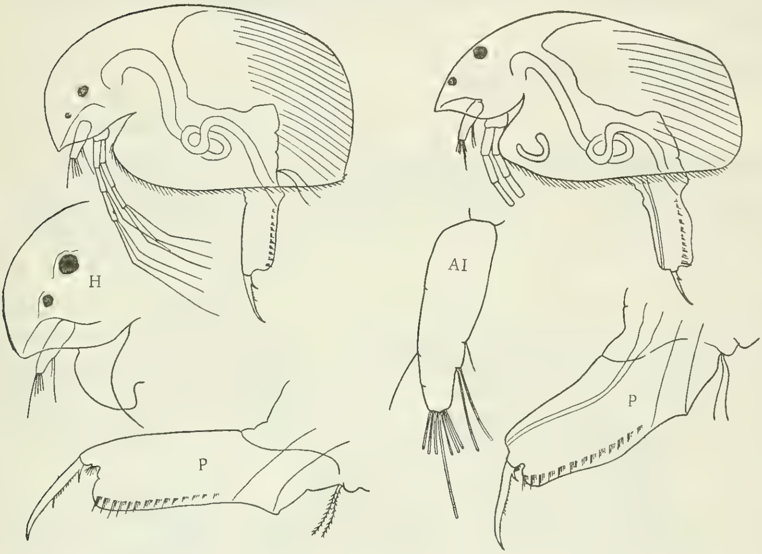

FIGURE 494. Acroperus neglectus, female and male (after Lilljeborg, 1900)

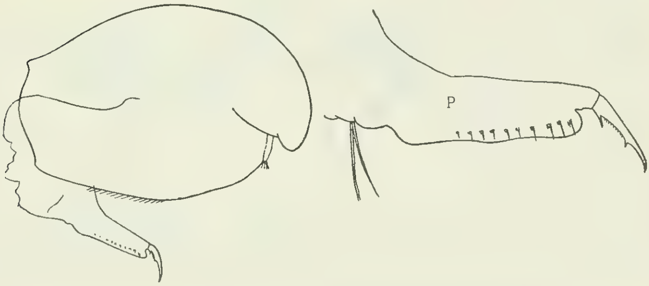

FIGURE 495. Acroperus sinuatus, female (after Henry, 1919)

the distal seta the longest, and with one basal denticle. Vas deferens opening ventrally near base of claws. Length to 0.54 mm.

Distribution. Europe.

5. Acroperus sinuatus Henry, 1919 (Figure 495)

Henry, 1919:471–472, Plate XL, Figures 5, 6.

Material. According to description.

Female. Posteroventral corner of valves rounded, without denticles. Posterodorsal corner forming a right angle. Rostrum blunt. Valves with lines. Antennules projecting beyond apex of rostrum. Lateral setae in 11 groups. Claws with a basal spine and a spine in middle of concave margin and with setae between the spines. Ocellus smaller than eye. Length to 0.59 mm.

Male. Unknown.

Distribution. Australia.

6. Acroperus alonoides Hudendorff, 1876 (Figures 496–500)

Hudendorff, 1876:51–52, Plate II, Figure 4; Ekman, 1940b:23–24, Figures A, B (harpae var. frigida syn.n.); Keilhack, 1907:459; Bening, 1941:255, Figure 105 (harpae frigida); Negrea, 1966a:140 (f. frigida).

Material. Numerous females from the Cherepovets and Rybinsk reservoirs, Sutka River, Yakot' River (below Zhestylev, Moscow Region), the Terek delta, and rivulets in New South Wales, Australia. Numerous males from the Cherepovets and Rybinsk reservoirs and from water bodies in the Terek delta; one male from a rivulet in New South Wales, Australia. Preparations: MGU – female 203, malformed female 1078, male 1179. ZIN – female 53854 (201), male 53856 (1178).

Female. Posteroventral corner of valves with 3 denticles. Distance from eye to margin of head not longer than width of eye. Rostrum blunt. Head keel low. Antennules conical. One of the distal sensory papillae longer than the others and almost as long as the antennule. Postabdomen with about 14 lateral denticles. Claw with a basal spine. Legs typical for the genus. Endopodite of leg IV rounded, seta 6 the smallest, seta 7 the largest (twice as long as width of exopodite). Exopodite of leg V slightly bifid. Ocellus smaller than eye. Length 0.85 mm.

Male. Posteroventral corner of valves with denticles. Keel reduced, eye and ocellus therefore situated near margin of head (at a distance of less than their width). Antennules projecting beyond apex of rostrum, with 12 esthetascs of different length including 10 at the end. Plate of labrum triangular. Postabdomen with distinct preanal corner. Anal denticles small. 413 Groups of lateral setae present. Claw with a basal spine. Vas deferens opening ventrally near base of claws. Legs typical for the genus. Leg I with a group of setae on anterior side of endite opposite the hook. Outer branch of endite of leg I with 3 setae of slightly different length. Exopodite of leg I with a seta projecting distinctly beyond the ends of the setae on the outer branch of the endite.

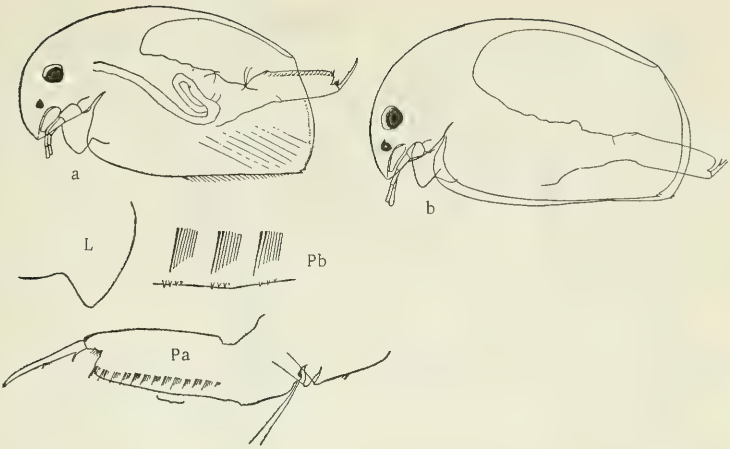

FIGURE 496. Acroperus alonoides, female (Cherepovets Reservoir, mouth of the Kovzha River, 16 September 1963):

a — female, length 0.57 mm; Pa — preparation 203; b — female with preserved valve of preceding stage, length 0.7 mm; Pb — part of armature of postabdomen, high magnification.

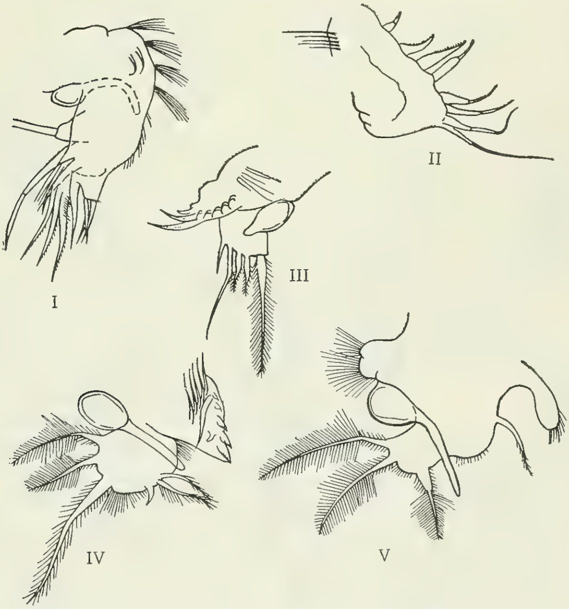

FIGURE 497. Legs of female of Acroperus alonoides (Cherepovets Reservoir, Goritsy, 21 October 1963):

I, IV — left legs, inner side; II, III — right leg, inner side;
V — right leg, outer side.

(412)

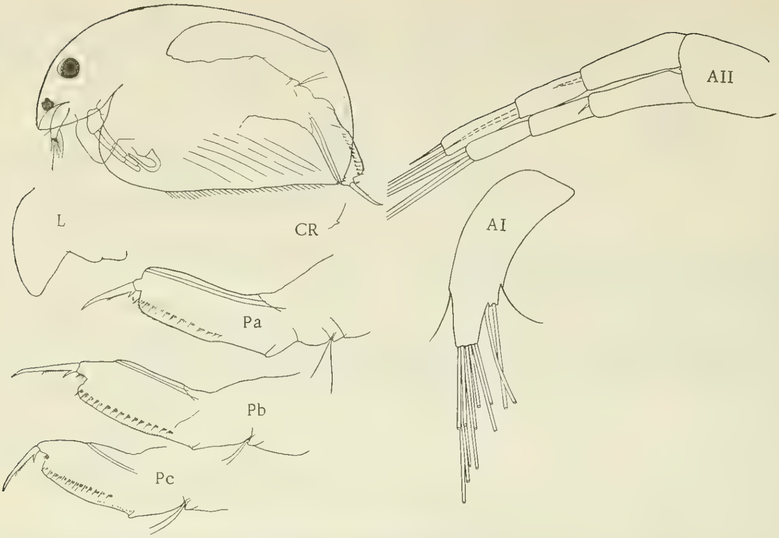

FIGURE 498. Acroperus alonoides, male, length 0.51 mm (Cherepovets Reservoir):

Pa — postabdomen; Pb — postabdomen of male 0.48 mm long; Pc — postabdomen of male 0.41 mm long (16 September 1963); AI, AII — 21 October 1963.

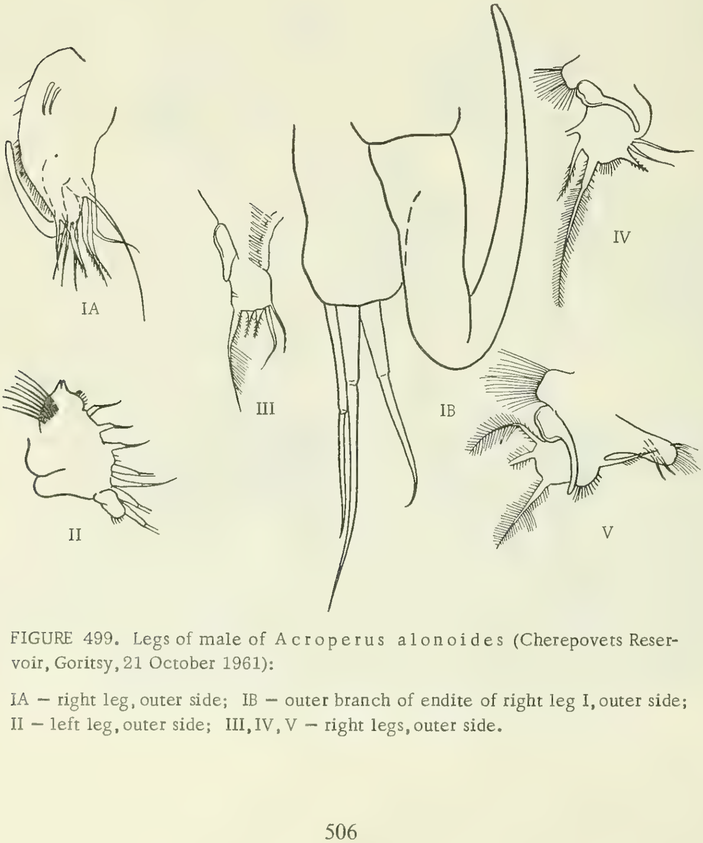

FIGURE 499. Legs of male of Acroperus alonoides (Cherepovets Reservoir, Goritsy, 21 October 1961):

IA — right leg, outer side; IB — outer branch of endite of right leg I, outer side; II — left leg, outer side; III, IV, V — right legs, outer side.

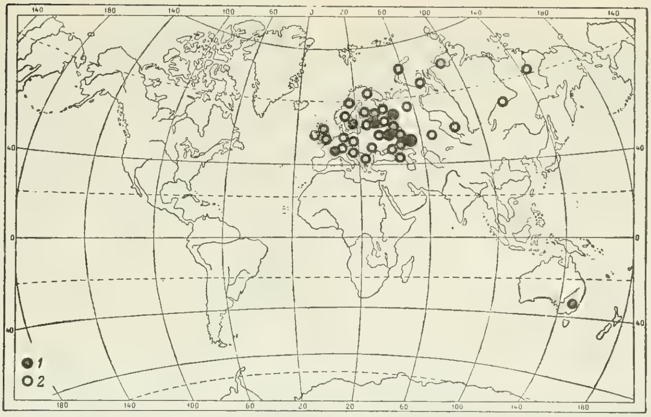

FIGURE 500. Distribution:

1 — Acroperus alonoides; 2 — A. elongatus elongatus.

In the juvenile male, the vas deferens opens some distance from the base of the claws.

Distribution. Europe, Australia. Northwestern part of the European USSR.

7. Acroperus elongatus (Sars, 1862)

Female. Valves with rounded posterodorsal corner; posteroventral corner usually with 1–2 denticles which are sometimes absent. Ventral margin of valves with small setae. Rostrum blunt, short. Head shield with rounded posterior margin. Valves with lines extending posteroventrally. Striation between lines directed anteroposteriorly. Three connected main head pores; lateral pores situated on margin of head shield. Ratio between distance from posterior pore to posterior margin of head shield and distance between pores about 1. Head shield with mainly longitudinal lines. Plate of labrum triangular. Antennules reaching to apex of rostrum. Posterior margin of antennules with a sensory seta and sensory papilla in the distal half. The other esthetascs situated on the distal end, one of them longer than the others. Antennae with spines on proximal segment of exopodite and on both distal segments. Proximal segment of endopodite with a short, 2-segmented seta.

Postabdomen of uniform width. Anal denticles 15–17, decreasing in size proximally. Lateral groups of setae present, distal setae of groups larger. Dorsal margin of postabdomen with projecting distal end; an incision between the end and the base of the claws. The margin adjacent to the base of the claws has an incision and a tubercle with a group of setae. Claws with a pubescent basal spine. Concave margin of claws with a row of setae; distal seta larger than the others, situated in middle of the concave margin; distal to this seta is a larger isolated seta. Intestine with a caecum (Lilljeborg, 1900). Ocellus smaller than eye, situated nearer to the eye than to the apex of the rostrum.

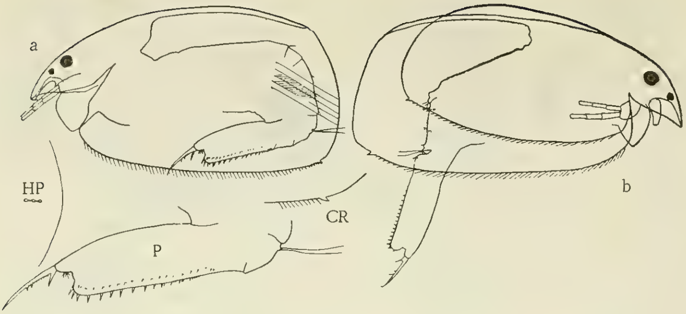

FIGURE 501. Acroperus elongatus elongatus:

a – female, length 0.74 mm (Rybinsk Reservoir); HP – Ivan'kovo Reservoir, 22 July 1962, preparation 270; P – Rybinsk Reservoir; b – female with not discarded valve of the preceding stage (Uglich Reservoir, 23 July 1962).

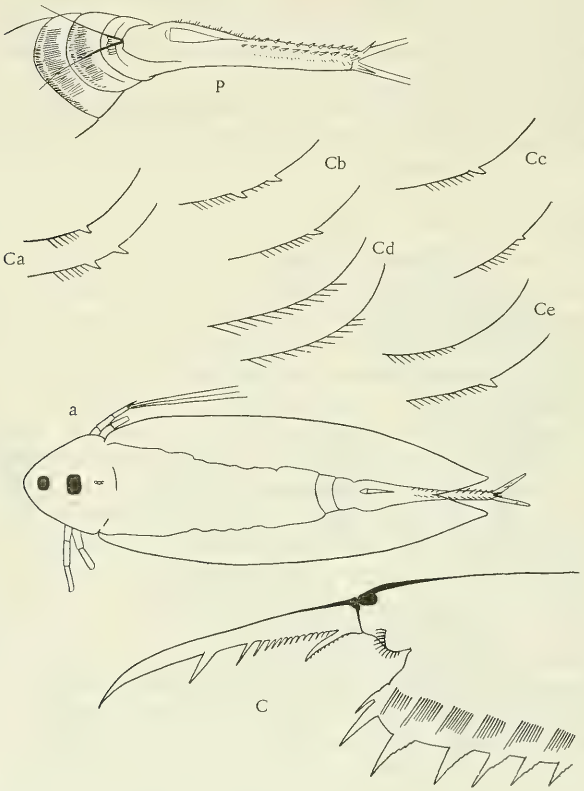

FIGURE 502. Acroperus elongatus elongatus, female:

P – postabdomen, dorsal (Uglich Reservoir, 23 July 1962); Ca – teeth on posteroventral corner of valves (top – left valve, bottom – right valve), this specimen had three not discarded valves of different stages, the teeth are the same on all valves (Ivan'kovo Reservoir, 22 July 1962, preparation 259); Cb – preparation 261; Cc – preparation 258; Cd – preparation 1048, Lake Seito, Komi ASSR; Ce – preparation 484, Uglich Reservoir, 23 July 1962; a – preparation 270, Ivan'kovo Reservoir, 22 July 1962; C – claw (Ivan'kovo Reservoir, 22 July 1962, preparation 262).

415 Integument of abdomen with characteristic supporting elements. Folds on dorsal side of abdomen accompanied by rows of setae. Legs typical for the genus (almost indistinguishable from those of Acroperus harpae), but markedly different from those of other genera. Setae and lobes on exopodites of legs IV, V, and VI densely pubescent. Epipodites of legs IV and V with long processes. The material from the Ivan'kovo and Uglich reservoirs contains numerous (9 of 100 preparations) malformed specimens and specimens with a different number of teeth on the posteroventral corner of the valves (Figure 502).

The retention of exuviae is common in our material and in that of other authors (Lilljeborg, 1900; Vereshchagin, 1912b; Herbst, 1955).

Male. Valves with rounded posterodorsal corner. Posteroventral corner rounded, with a denticle. Valves with lines. Rostrum blunt. Head shield with rounded posterior margin. Antennae projecting beyond apex of rostrum. Anterior margin distally with a 2-segmented flagellum. Posterior margin with a sensory seta and two sensory papillae distally. Other sensory papillae situated on the distal end. Postabdomen narrowing distally, without rows of anal denticles on dorsal margin but with lateral rows of groups of setae. Distal end of dorsal margin slightly concave, with a pubescent tubercle at base of claws. Ventral margin of postabdomen almost plane, with a tubercle distal to the middle. Claws with a row of spinules on the concave margin and with a small basal spine. Ocellus smaller than eye.

In the male (Figure 507) the claws of the postabdomen differ sharply from those of the female. Hook of leg I of male with pointed apex, its concave side with 5 spinules, the 3 distal spinules situated close together, the other 2 widely spaced (Figure 509). Anterior side of endite of leg I with a brush of setae opposite the hook. Outer branch of endite of leg I with 3 setae of slightly different length. Exopodite of leg I with a seta projecting beyond the ends of the setae on the outer branch of the endite. Vas deferens opening ventrally at base of claws.

Biology. Inhabits the bare littoral.

Key to Subspecies of A. elongatus according to Females

1 (2). Less than 30 longitudinal lines in widest part of valve, lines not anastomosed . . . . 7a. A. elongatus elongatus (Sars, 1862).
2 (1). Thirty-five longitudinal lines in widest part of valve, lines anastomosed into rectangles . . . . 7b. A. elongatus jamaliensis (Werestschagin, 1913).

7a. Acroperus elongatus elongatus (Sars, 1862)
(Figures 500–510)

Zaddach, 1844:30 (Lynceus macrourus); Leydig, 1860:219–221, Plate IX, Figures 66–67 (Lynceus); Sars, 1862a:161 (Alona elongata); 1862 (Alonopsis elongata); Schoedler, 1863:33 (intermedius); P. E. Müller, 1867:170, Plate IV, Figure 28 (Alonopsis); Norman and Brady, 1867:23, Plate XVIII, Figure 1, Plate XX, Figure 2 (Lynceus elongatus); Brady, 1868:421–422, Figure 8 (L. elongatus); Frič, 1872 (L. lacustris); Stingelin, 1895:241–242 (Alonopsis elongata); Lilljeborg, 1900: Plate LXV, Figures 5–20; Doolittle, 1913:563–565, Plates 42, 43 (Alonopsis aureola); Bening, 1941:256–258, Figure 106; Frey, 1959:34, Figures 69–70; 1962a, Figures 69–70; Šrámek-Hušek et al., 1962:325–326, Figure 119; Herbst, 1962:82–84, Figure 58; Smirnov, 1966a:114–134, Figures 1–10 (elongatus).

Material. Numerous females from the Ivan'kovo, Uglich and Rybinsk reservoirs, and from the Komi ASSR; 3 females from Lake Muolan-Yarvi on the Karelian Isthmus. Numerous males from the Rybinsk Reservoir; several males from Lake Diyaty (Vashutkiny Lakes, Arkhangel'sk Region). Preparations: MGU – females 262, 258, 261, 528, 259, 270, 484, 1048, 538, 621, 521, 626, 1125, malformed females 145, 149, 146, 486, 263, males 1382, 1381, juvenile male 1379. ZIN – female 53858 (1100), male 53857 (1380). Ph – female 312. Professor Frey's collection (U.S.A.). Females from the Ivan'kovo and Uglich reservoirs and from Lake Seito (Arkhangel'sk Region).

Female. Valves with longitudinal lines which are not anastomosed, about 28 in widest part of valve. About 18 such lines at the posterior margin. Height 56 to 59% of length. Length 0.51 (1st stage) to 0.85 mm, minimum length of gravid specimens (3rd stage) 0.69 mm (upper reaches of Volga, June 1960).

Male. Valves with longitudinal lines which are not anastomosed; about 26 lines in widest part of valve and about 16 at the posterior margin. Length to 0.65 mm.

Distribution. Holarctic Region. European USSR, to the Ob' basin in the East.

7b. **Acroperus elongatus jamaliensis** (Werestschagin, 1913)

Vereshchagin, 1913a:201–202, Figures 23, 24 (Alonopsis elongata var. jamaliensis).

Female. Valve with parallel longitudinal lines, 35 lines in widest part of valve. Lines anastomosed, forming rectangles. Length 0.4 mm.

Distribution. Yamal.

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8. **Acroperus titi** (Harding, 1955) comb. nov. (Figure 511)

Harding, 1955:346–347, Figures 71, 72 (Alonopsis titi).

Material. Holotype, British Museum, 66. 1954. 8. 9. 80.

Female. Ventral margin of valve most strongly convex before middle. Posterior margin about half of maximum height. Posteroventral corner of valve rounded, without denticles. Antennules reaching to apex of rostrum. Preanal corner of postabdomen not projecting. Dorsal margin of postabdomen with small denticles decreasing in size proximally. Eleven groups of setae laterally, the distal seta largest in each group. The distal setae of the distal groups project beyond margin of postabdomen. Claws with

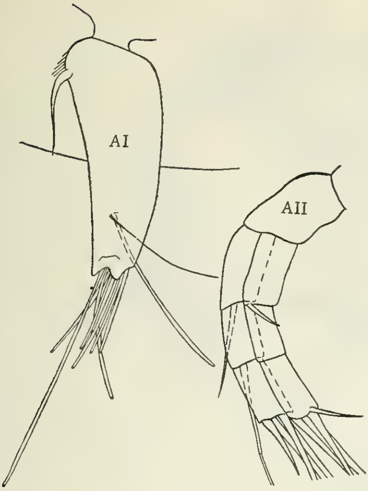

FIGURE 503. Acroperus elongatus elongatus, female:

AI — left antennule, ventral (Uglich Reservoir, 23 July 1962); AII — left antenna, outer side (Ivan'kovo Reservoir, 22 July 1962, preparation 262).

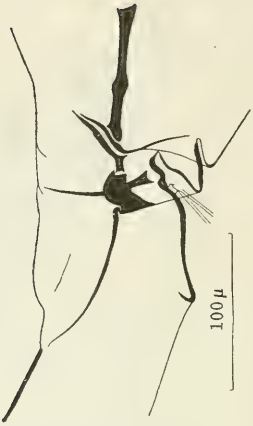

FIGURE 504. Supporting elements of abdominal integument of female of Acroperus elongatus elongatus (Uglich Reservoir, 23 July 1962)

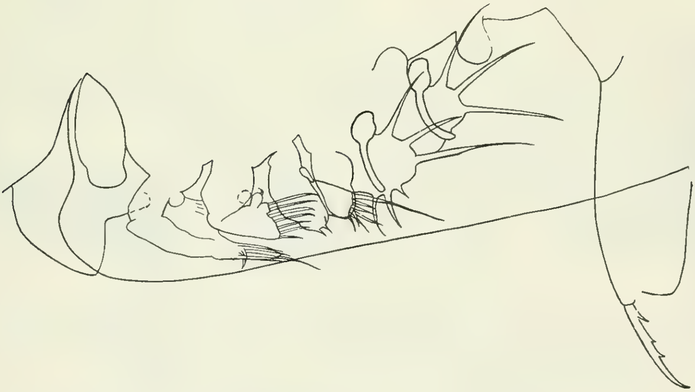

FIGURE 505. Arrangement of legs of female of Acroperus elongatus elongatus (Uglich Reservoir, 23 July 1962, formalin-fixed material)

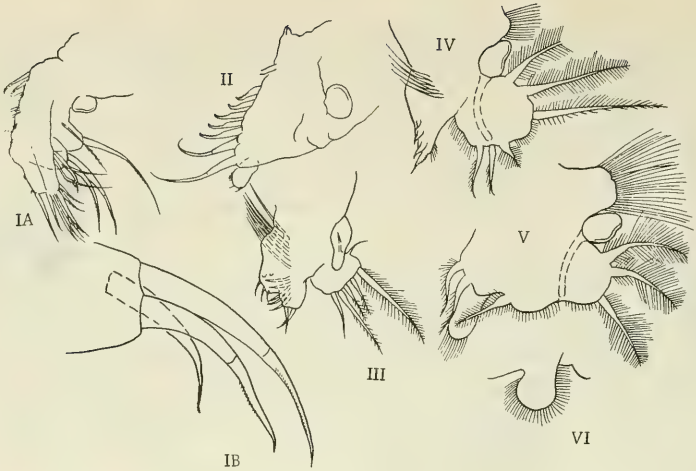

FIGURE 506. Legs of female of Acroperus elongatus elongatus (Uglich Reservoir, 23 July 1962):

IA, IV, V — right legs, inner side; IB — outer branch of endite of left leg I anteriorly; II — right leg, outer side; III — left leg, inner side; VI — left leg, outer side.

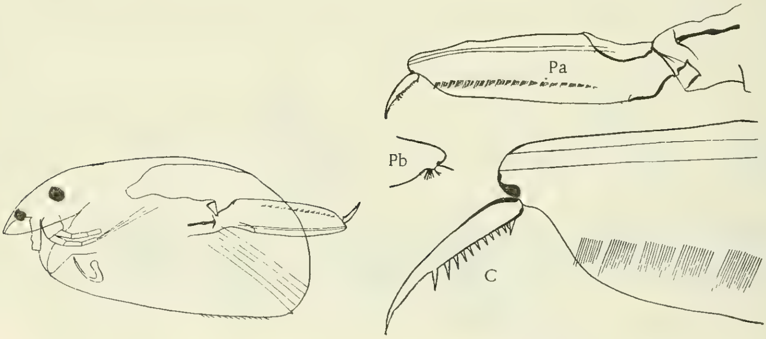

FIGURE 507. Acroperus elongatus elongatus, male (Lake Diyaty, Vashutkiny Lakes, Arkhangel'sk Region, 2 September 1962):

Pa, Pb, C — preparation 1381.

418)

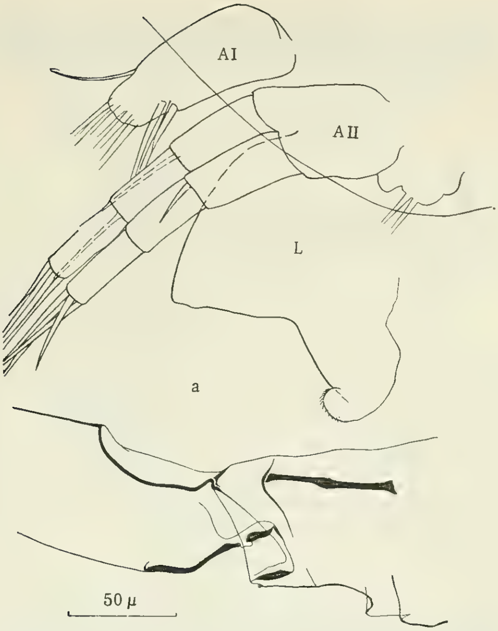

FIGURE 508. Acroperus elongatus elongatus, male (Lake Diyaty, 2 September 1961):

AI, AII – left antenna and antennule; a – supporting elements of posterior part of abdomen and postabdomen, preparation 1381.

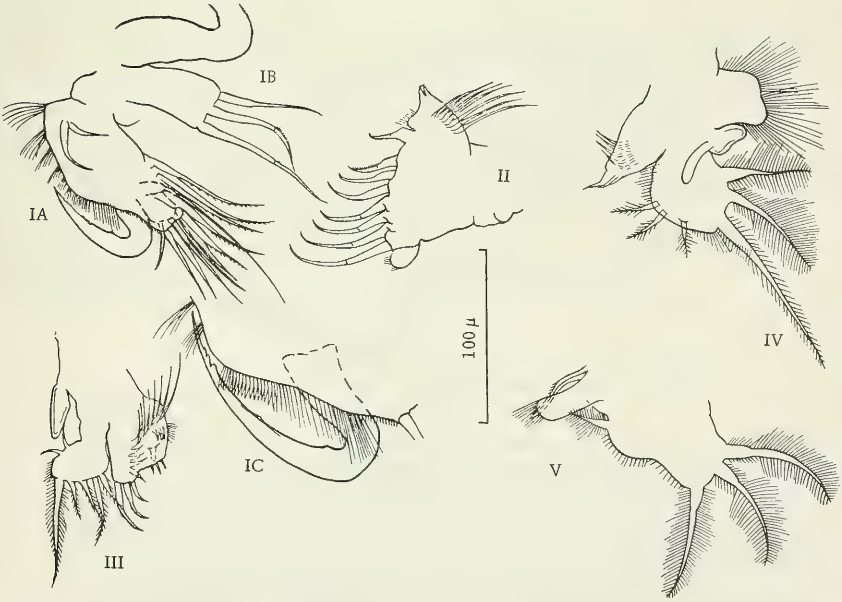

FIGURE 509. Legs of male of Acroperus elongatus elongatus (Lake Diyaty, 2 August 1961):

IA – leg I; IB – outer branch of endite of left leg I, inner side; IC – hook of leg I, high magnification.

420 setae on the concave margin, small seta in middle of concave margin larger than the others. Eye and ocellus situated at margin of head. Ocellus smaller than eye. Length 0.52 mm.

(419)

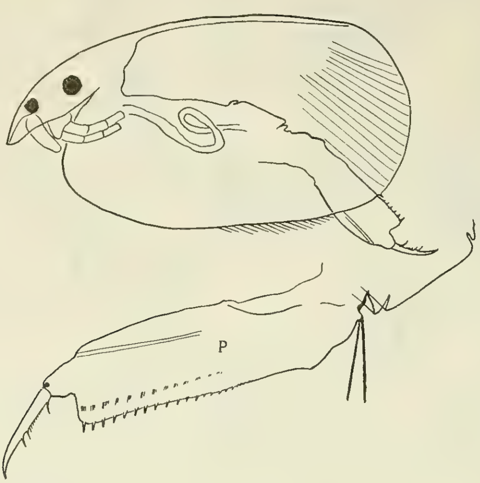

FIGURE 510. Acroperus elongatus elongatus, juvenile male, length 0.56 mm (Lake Diyaty, 2 September 1961, preparation 1379)

Male. Unknown.

Distribution. South America (basin of Lake Titicaca).

(419)

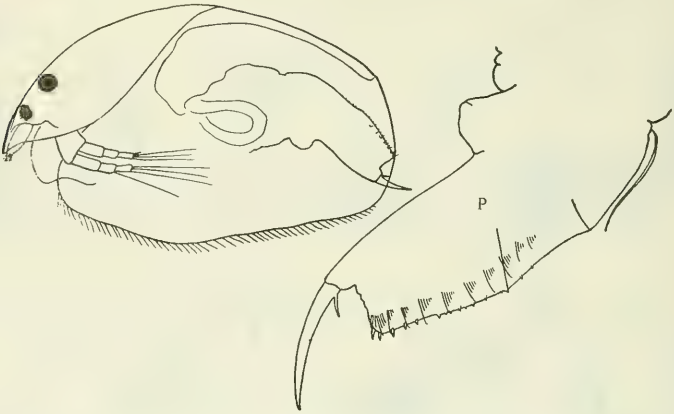

FIGURE 511. Acroperus titi, female (after Harding, 1955)

Species incertae sedis

Acroperus harpae var. dispar Keilhack, 1907:458.

Acroperus harpae var. madüensis Keilhach, 1905:154–158, Figures 9–12.

Acroperus switeziánus Dybowski and Grochowski, 1895:149 (Alonopsis switeziana). Nomen nudum.

Acroperus transylvanicus Daday, 1884:181.

Acroperus wojnowiensis Dybowski and Grochowski, 1895:149. Nomen nudum.

15. Genus Kozhowia G. L. Vasiljeva and N. N. Smirnov, 1969

Vasil'eva and Smirnov, 1969:185.

Body of female oval. Posterior margin of valves slightly shorter than maximum height. Corners of valves rounded. Head not divided from body, without keel. Dorsal keel absent. Three main head pores with a narrow connection between them. Small pores situated lateral to the main pores, near them. Antennules not reaching apex of rostrum. Plate of labrum oval, with rounded apex. Integument of abdominal part of body with chitinized elements (apodeme and fulcrum). Penultimate abdominal segment with saddle-shaped dorsal side.

Postabdomen elongate but less than in species of Camptocercus, ratio of length:width 3 to 4.3. Dorsal distal corner of postabdomen not differentiated. Anus situated in proximal part of postabdomen. Anal denticles present. Claw with a basal spine and with setae on the concave margin. Ventral margin of valves with setae on the whole margin. Processes on dorsal side of abdominal part absent.

Leg I with a seta on the exopodite; outer branch of endite with 3 setae. Endite of leg II with 8 hard setae, without soft setae. Leg II with small exopodite with one seta. Exopodites of legs III and IV small. Exopodite of leg V with 4 setae. Postabdomen elongate and slightly curved, but shorter than in Camptocercus. Head keel and dorsal keel absent. Abdominal part of body with chitinized elements in the lateral walls. Penultimate abdominal segment with saddle-shaped dorsal side. The genus Kozhowia is apparently intermediate between Alona and Camptocercus; it differs from Alona in the form of the postabdomen and from Camptocercus in the relatively short postabdomen and the small number of anal denticles.

Type species: Kozhowia kozhowi G. L. Vasiljeva and N. N. Smirnov, 1969.

The genus is named after the late Professor M. M. Kozhov.

Key to Species of the Genus Kozhowia according to Females

1 (2). Postabdomen short, ratio of length:width about 3 . . . . 1. K. baicalensis G. L. Vasiljeva and N. N. Smirnov, 1969.
2 (1). Postabdomen elongate, ratio of length:width about 4.
3 (8). Anal denticles long, thin, simple (distal denticle sometimes bifid).
4 (5). Basal spine erect, diverging from the claw. Concave side of claws with small, dense setae . . . . 2. K. primigenia G. L. Vasiljeva and N. N. Smirnov, 1969.

5 (4). Basal spine adpressed to claw, very long. Concave side of claw with large sparse setae.
6 (7). Basal spine reaching the middle spinule on concave side of claw. Anal denticles long. Postabdomen slightly curved . . . . 3. **K. gajewskajae** G. L. Vasiljeva and N. N. Smirnov, 1969.
7 (6). Basal spine ending distinctly before middle spinule on concave side of claw. Anal denticles small. Postabdomen almost straight . . . . 4. **K. brevidentata sp. n.**
8 (3). Anal denticles short, wide, multicuspid . . . . 5. **K. kozhowi** G. L. Vasiljeva and N. N. Smirnov, 1969.

Key to Known Males of the Genus Kozhowia

1 (2). Claw of postabdomen with erect basal spine . . . . . 1. **K. baicalensis.**
2 (1). Claw of postabdomen with closely adpressed basal spine . . . . 4. **K. brevidentata.**

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1. **Kozhowia baicalensis** G. L. Vasiljeva and N. N. Smirnov, 1969 (Figures 512–525, 519)

Vasil'eva Vasil'eva and Smirnov, 1969:185–188, Figures 1, 2.

Material. Numerous females from Lake Baikal (near Bol'shie Koty and the rivers Utulik-Murina); 2 ephippial females and 1 male (Utulik-Murina); 1 male from Lake Baikal at Bol'shie Koty.

Holotype. MGU – female 2120, male 2228.

Paratypes. ZIN – female 53850 (2116), male 53851 (2259). BGI (Biological-Geographical Institute of Irkutsk State University) – female 2114. British Museum female No. 64. 5. 1969. 1. 7. 1. (2254). Preparations: MGU – ephippial female 601. ZIN – ephippial female 633.

Female. Maximum height in middle. Dorsal margin of head and dorsal side of valves forming a smooth curve. Posterior margin of valve curved. Ventral margin of valves plane, with a small process before the middle. Valves with weak longitudinal lines. The longitudinal lines are connected by transverse lines, forming rectangles in some places. Rostrum blunt. Three main head pores, connected by a narrow line. Antennules ending before apex of rostrum about a quarter of their length; esthetascs projecting beyond apex of rostrum. Setae on antennae: 0–0–3/0–0–3. Examination of numerous females showed that only the distal setae were present. Spines on antennae: 0–0–1/1–0–1. Plate of labrum small, rounded triangular, with rounded apex.

Dorsal side with 4 segments with distinct setae in abdominal part. Postabdomen elongate, gradually narrowing, without differentiated distal margin and dorsal distal corner. Anal margin slightly concave. Preanal corner distinct, blunt, not strongly projecting. Preanal margin slightly longer than anal margin; postanal margin about twice as long as anal margin. Anal denticles long, usually about 10, rarely less, gradually decreasing in size proximally. Distal anal denticle with additional setules on the proximal side. Lateral setae in 7 groups, distal seta the largest in

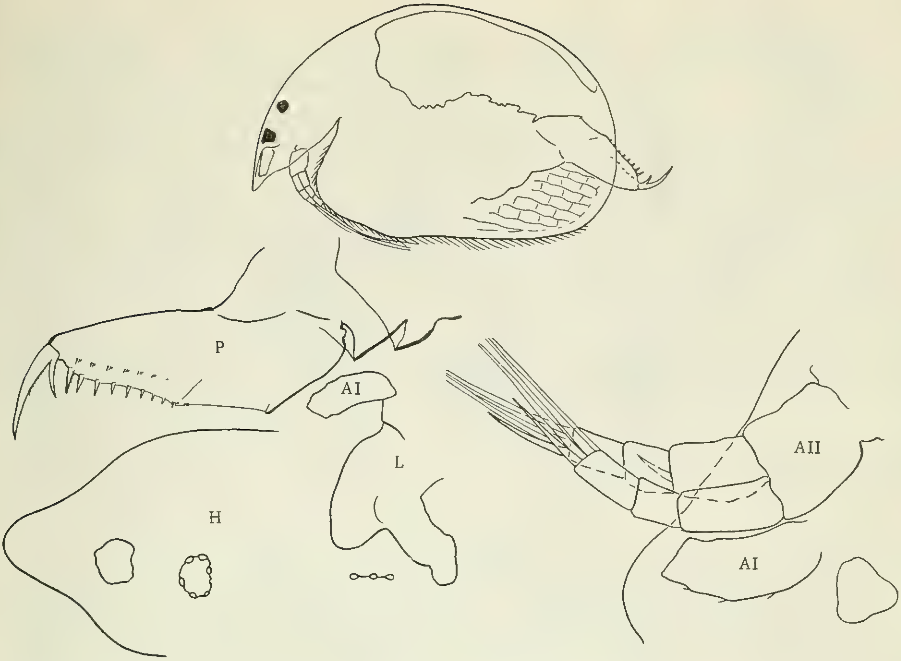

FIGURE 512. Kozhowia baicalensis, female, length 0.51 mm (Lake Baikal, the rivers Utulik-Murina, 28 July 1964):

H — head and head pores (distance between pores and eye shown); AI, AII — antennule and antenna (left side, ventral).

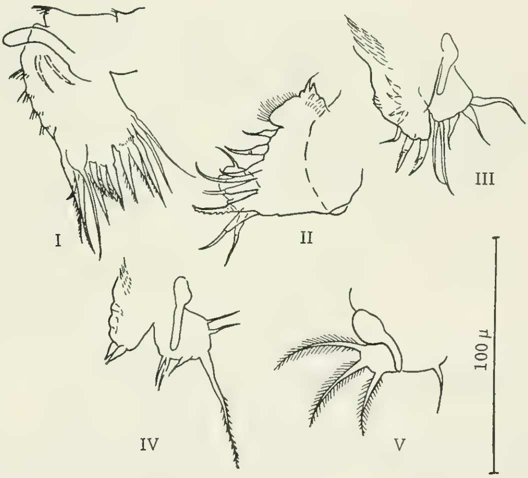

FIGURE 513. Legs of female of Kozhowia baicalensis (Lake Baikal, the rivers Utulik-Murina, 28 July 1964):

I, III, IV — left legs, outer side; II — left leg, inner side; V — right leg, outer side.

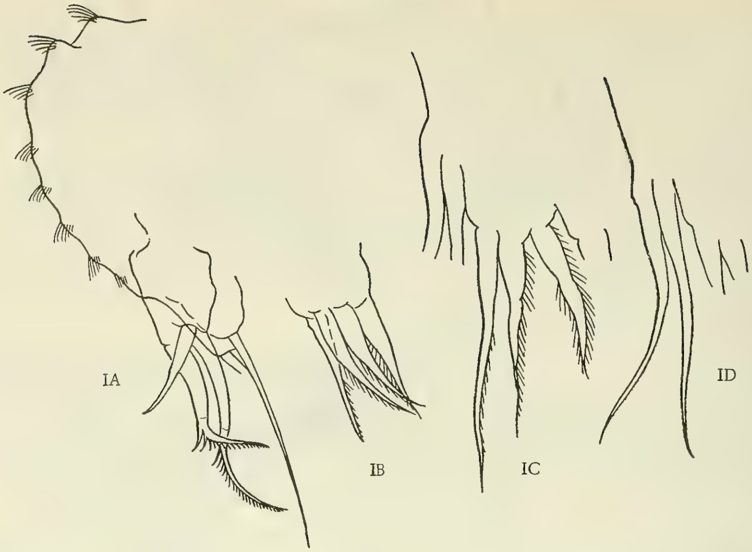

FIGURE 514. Lobes of leg I of female of Kozhowia baicalensis:

IA — exopodite and outer branch of endite; IB — anterior lobe of inner branch of endite; IC — posterior lobe of inner branch of endite; ID — setae on posterior side of endite.

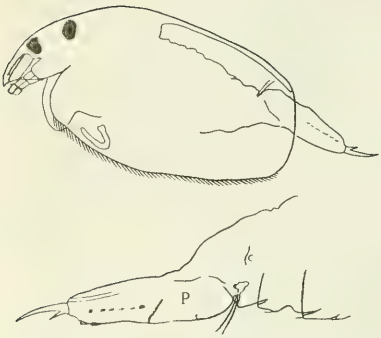

FIGURE 515. Kozhowia baicalensis, male, length 0.36 mm (Lake Baikal, the rivers Utulik-Murina, 22 August 1966, preparation 2228)

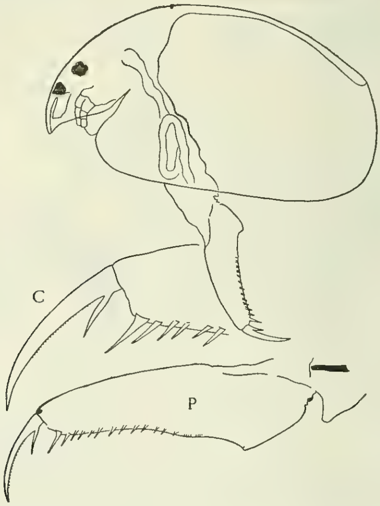

FIGURE 516. Kozhowia primigenia, female, length 0.47 mm (Lake Baikal at Bol'shie Koty, 20 September 1967, preparation 2260)

each group. Claws and basal spine large. Concave margin of claws with small setae in proximal half; the distal seta larger than the others.

Outer branch of endite of leg I with 3 setae, of these 2 long brushlike setae of about equal length with distal setules on one side; the setae gradually decrease in size distally. Inner seta small, hook-shaped. Anterior lobe of inner branch of endite with 4 setae, posterior lobe with 3 setae. Epipodite with a long process. Endite of leg II with 8 hard setae; seta 6 (counting from gnathobase) with large chitinized tubercle-shaped setules on one side in distal part. Exopodite small, rounded, with a short seta. Leg III with a small square exopodite with 5 setae on the posterior margin. Epipodite with a long process. Leg IV with a small round exopodite with 6 setae. One of these setae about twice as long as the width of the exopodite, the others short. Epipodite with a long process. Leg V with an oval exopodite with 4 setae. Epipodite with a long process. Leg VI in form of a small lobe.

Ocellus situated slightly nearer to eye than to apex of rostrum. Ocellus slightly larger than eye. Parthenogenetic females with 2 eggs, ephippium with a single egg. Length 0.51 mm.

Male. Valves with rounded posterodorsal corner. Posteroventral corner rounded, without denticles. Dorsal margin of head and dorsal side of valves forming a smooth curve. Antennules almost reaching apex of rostrum. Integument with an apodeme and fulcrum in abdominal part. Penultimate abdominal segment with saddle-shaped dorsal side. Dorsal and ventral margin of postabdomen straight. Preanal corner not differentiated. Distal dorsal corner absent. Anal denticles forming 2 groups of setae in distal part of postabdomen. Lateral setae in 6 groups. Claws with a basal spine. Vas deferens opening at base of claws, ventral to them. Length 0.36 mm.

Kozhowia baicalensis differs from related species in the form of the postabdomen.

Distribution. Lake Baikal: Bol'shie Koty inlet, littoral of open Lake Baikal between the rivers Utulik-Murina.

Biology. Found at a depth of 1 to 20 m. Inhabits stony bottom, pure or covered with sand and silt, and on pure and silty sand. Egg-bearing females occur already in June, ephippial females in June and August. The density of this species attains 1,300 specimens per m^2 (Tables 26, 27, p. 177). One specimen contained endoparasites which caused malformation of the postabdomen.

2. **Kozhowia primigenia** G. L. Vasiljeva and N. N. Smirnov, 1969 (Figures 516, 519)

Vasil'eva and Smirnov, 1969:188–190, Figures 3, 1a, b, c.

Material. Six females from Bol'shie Koty, Lake Baikal.

Holotype. MGU – female 2260.

424 Paratypes. ZIN – female 53853 (2263). BGI – female 2261.

Female. Maximum height in middle. Valves with weak longitudinal lines. Antennules almost reaching apex of rostrum. Plate of labrum with rounded apex. Abdominal part of body with chitinized elements (apodeme and fulcrum).

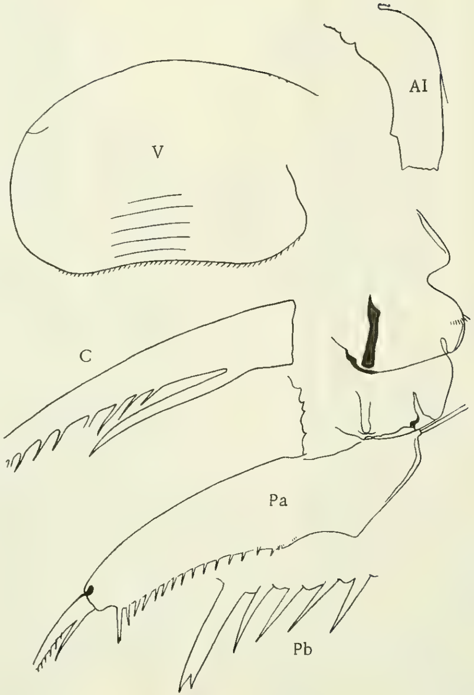

FIGURE 517. Kozhowia gajewskajae, female (Lake Baikal at Bol'shie Koty, 12 August 1966):

AI — left antennule, ventral; Pa — preparation 2249; Pb — distal anal denticles.

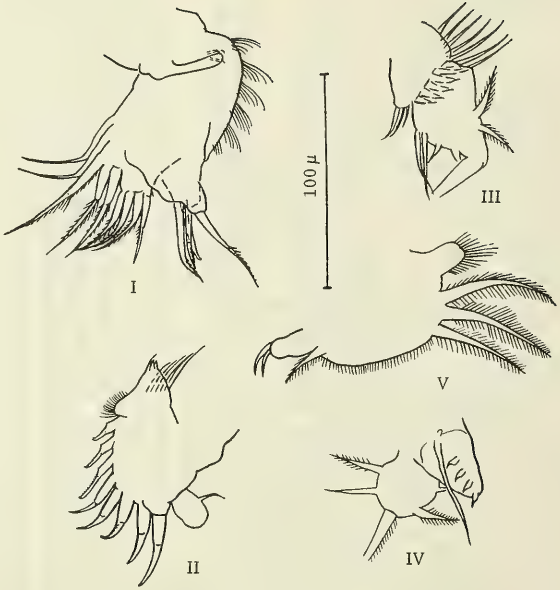

FIGURE 518. Legs of female of Kozhowia gajewskajae:

I, II — right legs, outer side; III — right leg, inner side; IV — left leg, inner side; V — left leg, outer side.

Postabdomen elongate, slightly curved. Ventral margin of postabdomen slightly convex, dorsal margin slightly concave. Preanal corner distinct, blunt. Preanal margin half as long as postanal margin. About 14 anal denticles, decreasing in size toward the anus. Anal denticles long, thin. Claw with a basal spine which is slightly longer than basal width of claw. Concave margin of claw with very small setae. Ocellus almost as large as eye, situated slightly nearer to eye than to apex of rostrum. Length 0.47 mm.

Male. Unknown.

Distribution. Lake Baikal (Bol'shie Koty).

Biology. Found at a depth of 5–6 m on sand and stones in September.

This species is distinguished by the following characters: Anal denticles long, thin, simple, numerous. Basal spine of claw moderately long, diverging from the claw. Concave margin of claw with very small, dense setae. The species has some primitive characters: the simple anal teeth and the normal claws.

3. Kozhowia gajewskajae G. L. Vasiljeva and N. N. Smirnov, 1969 (Figures 517–19, 521)

Vasil'eva and Smirnov, 1969:190–191, Figure 3 (2–5).

Material. Two females from Lake Baikal (Bol'shie Koty).

Holotype. MGU – female 2249 (valve and postabdomen).

Paratype. British Museum.

Female. Valves with weak longitudinal lines connected by transverse lines and finely granulate. Ventral margin of valve slightly concave, with setae. Three main head pores. Small pores situated lateral to the main pores, near them. Antennules almost reaching apex of rostrum. Antennules 3 times as long as wide. Integument of abdominal part with apodeme and fulcrum. Penultimate abdominal segment with saddle-shaped dorsal side.

Postabdomen elongate, slightly curved. Ventral margin of postabdomen slightly convex, dorsal margin slightly concave. Preanal corner distinct. Ratio between length of postanal and preanal margin about 3:2. Anal denticles 16, decreasing in size toward the anus. Proximal denticle small, accompanied by setae, a group of setae proximal to it. Distal anal denticle markedly larger than the others, with bifid apex. Third and fourth teeth directed apically toward apex of first denticle. Other anal denticles parallel to first denticle.

Claws with a long basal spine, about 2.5 times as long as basal width of claw. Basal spine usually parallel to claw, adpressed to it. Concave margin of claw with sparse, coarse setae.

Five pairs of legs. Leg I with transverse rows of setules on anterior side of endite. Exopodite with a large seta with setules on one side in the distal half. Outer branch of endite with 3 setae, the inner setae much shorter than the outer two. Anterior outer seta brushlike, with dense setules on one side in the distal half. Posterior outer seta hook-shaped, with short distal part, more strongly chitinized than the other setae on the outer branch of the endite. Anterior lobe of inner branch of endite with

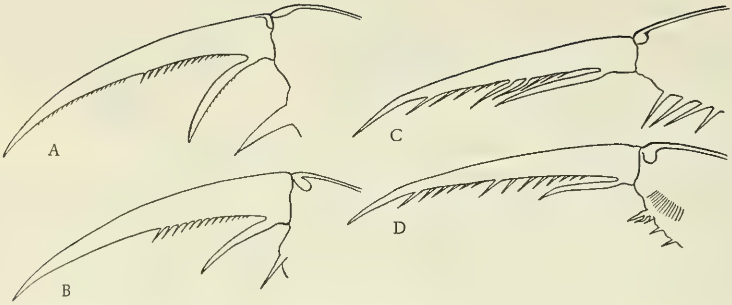

FIGURE 519. Claws of species of Kozhowia:

A — K. baicalensis (Lake Baikal, Bol'shie Koty, 15 September 1967, preparation 2258); B — K. primigenia (Lake Baikal, Bol'shie Koty, 15 September 1967, preparation 2264); C — K. gajewskajae (Lake Baikal, Maloe More, Kharga Tui, 26 August 1968, preparation 2350); D — K. brevidentata (Lake Baikal, Varnachka, 15 July 1968, preparation 2346).

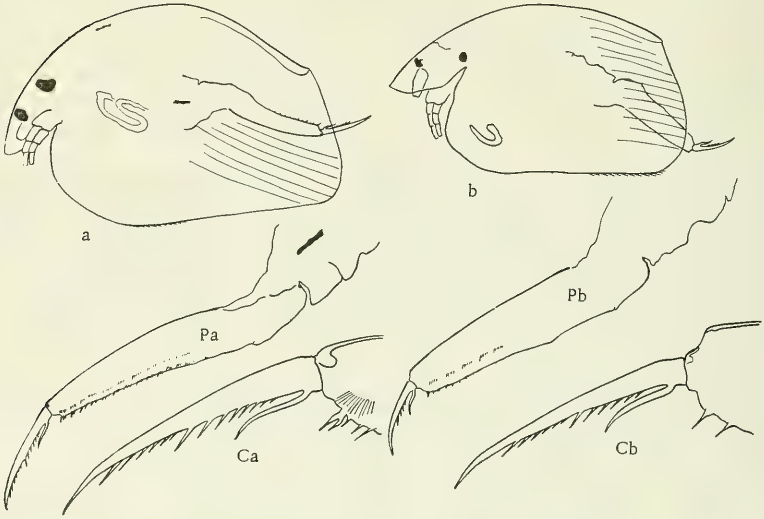

FIGURE 520. Kozhowia brevidentata (Lake Baikal, Varnachka, 15 July 1968):

a — female, preparation 2346; b — male, preparation 2354.

4 setae of about equal length. One of these setae less feathered than the others and directed toward ventral margin of valve (the other setae are directed posteriorly). Posterior lobe of inner branch of endite with 3 setae feathered on one side of about equal length. These setae are 1.5 times as long as the setae of the anterior lobe. Posterior side of endite with 2 thin, long setae. Epipodite with a long process. Leg II with a small exopodite with 1 short seta. Endite with 8 hard setae. Seta 6 (from the gnathobase) most strongly chitinized. Soft setae on endite absent. Filtering fan of gnathobase with 7 setae.

Leg III with a larger exopodite with 7 setae, 2 of them on the dorsal side. Two anterior setae of equal form and length. Endite with soft and hard setae. Gnathobase with a filtering fan of 7 setae. Leg IV with rounded exopodite which is almost as large as the exopodite of leg III. Leg V with oval exopodite with 4 setae, including a smaller seta on the anterior side. A lobed preepipodite and lobed endite present. Endite with 2 setae.

Length of valves 465μ, length of postabdomen (without claw) 200μ, length of antennae 85μ (rami and basal segment), length of antennules 55μ.

427 Male. Rostrum blunt, with an apical platform. Antennules almost reaching apex of rostrum. Anal denticles present, small. Vas deferens opening at base of claws, ventral to them. Length 0.56 mm. Preparation: MGU – 2459.

Juvenile male. Rostrum blunt but without apical platform. Antennules not reaching apex of rostrum. Anal denticles developed. Vas deferens opening on ventral side some distance from base of claws. Hook of leg I weakly developed. Length about 0.46 mm. Preparation: MGU – 2481.

Distribution. Lake Baikal (Bol'shie Koty).

Biology. Found at a depth of 1.8–8 m, on sand and stones, in August–September.

This species is distinguished by the following characters: anal denticles thin, long. Basal spine adpressed to claw. Concave margin of claw with coarse, sparse setae. Named after Professor N. S. Gaevskaya.

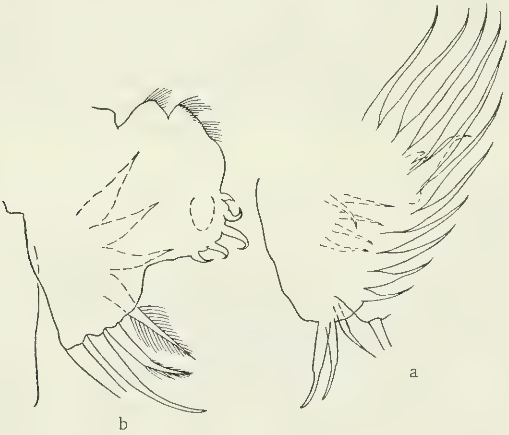

FIGURE 521. Gnathobase and endite of leg III:

a – Kozhowia gajewskajae; b – Leydigia leydigi.

4. Kozhowia brevidentata G. L. Vasiljeva and N. N. Smirnov sp. n. (Figures 519, 520)

Material. Holotype: one female from Lake Baikal, Varnachka, preparation 2346; one male from Lake Baikal, Varnachka, preparation 2354.

Female. Valve with longitudinal lines. Posteroventral corner rounded, without denticles. Three connected main head pores. Antennules not reaching apex of rostrum. Rostrum blunt. Abdominal integument with skeletal elements.

Postabdomen long, straight. Preanal corner not projecting. Anal denticles small, in 14 groups, decreasing in size toward the anus. Distal anal denticle trifid in the type. Groups of lateral setae present.

Claws with large setae on the concave margin, setae in proximal half larger than those in distal half. The setae become larger distally in both groups, the last seta of the proximal row situated in middle of claw. Apex of claw without setae, forming a continuation of the claw at a slight angle, not in a slight curve. Basal spine ending far before middle of claw (i. e., before the middle seta) and adpressed to claw. Intestine forming loops. Ocellus slightly smaller than eye, situated in middle between eye and apex of rostrum. Length 0.6 mm.

Male. Valves with longitudinal lines. Posteroventral corner of valves rounded, without denticles. Rostrum blunt. Antennules not reaching apex of rostrum.

Postabdomen elongate, straight. Preanal corner indistinct. Anal denticles small, not numerous (about 7). Groups of lateral setae present. Claw with a basal spine resembling claw of female. Vas deferens opening at base of claws, ventral to them. Ocellus as large as eye. Length 0.51 mm.

428 This species is named after the small anal denticles on the postabdomen; the other species of the genus have large anal denticles.

This species is closely related to K. gajewskajae. But K. brevidentata differs from K. gajewskajae as follows: basal spine of claw shorter (though also adpressed to claw); concave side of claw with shorter setae; postabdomen longer, straighter. Ratio between length and width of postabdomen 4–5 in K. gajewskajae, 5.6 in K. brevidentata. The anal denticles are very small and grouped in K. brevidentata, long and isolated in K. gajewskajae.

5. Kozhowia kozhowi G. L. Vasiljeva and N. N. Smirnov, 1969 (Figure 522)

Vasil'eva and Smirnov, 1969:191, Figures 4, 1a, b, c.

Material. Several females from Lake Baikal (littoral of the open Lake Baikal between rivers Utulik-Murina).

Holotype. MGU – female 2229.

Paratype. ZIN – female 53852 (2246), BGI – female 2257.

Female. Maximum height in the middle. Outline of head and dorsal side of valves forming a smooth curve. Ventral margin of valve plane. Ratio of length:height about 5:3. Sculpture of valve in form of fine granules and weak longitudinal lines in posterior half of valve.

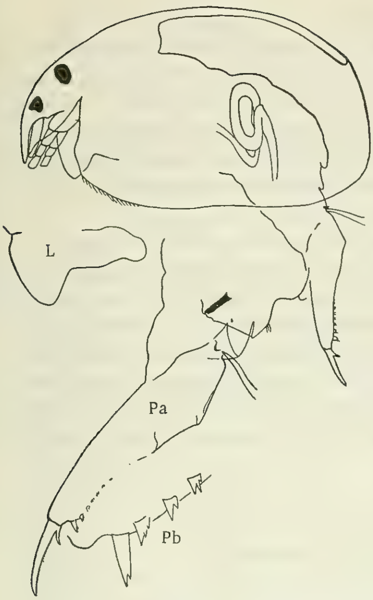

FIGURE 522. Kozhowia kozhowi, female, length 0.4 mm (Lake Baikal, near the rivers Utulik and Murina, 22 August 1966, preparation 2229):

Pb – distal anal denticles.

Antennules almost reaching apex of rostrum. Setae on antennae: 0–0–3/0–1–3. Distal segments of antenna with spines. Plate of labrum rounded, triangular, with rounded apex and a small seta near the apex.

Penultimate abdominal segment with saddle-shaped dorsal side, its lateral integument with an apodeme. Postabdomen elongate, slightly curved. Ventral margin of postabdomen slightly convex, dorsal margin slightly concave. Preanal corner blunt. Postanal margin about twice as long as preanal margin. Anal denticles about 11, decreasing in size toward the anus, multicuspid; proximal anal denticles accompanied by setae on their proximal side; terminal group near anus represented by a group of setae. Distal anal denticle much longer than the others. Claw with a large basal spine. Concave margin of claw with setae; proximal half with larger setae ending in a large seta in middle of concave margin.

Epipodites of legs III, IV, and V with long processes.

Ocellus smaller than eye, situated slightly nearer to eye than to apex of rostrum. Length 0.4 mm.

Male. Rostrum blunt, with apical platform. Antennules not reaching apex of rostrum. Postabdomen dorsally with single, small anal denticle. Length 0.37 mm. Preparation: MGU – 2434.

Distribution. Littoral of open Lake Baikal between rivers Utulik and Murina.

Biology. Found at a depth of 10 m in August on clay bottom.

This species differs from related forms in the multicuspid anal denticles, the small, diverging basal spine of the claw, and the short setae on the concave margin of the claw.

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16. Genus Camptocercus Baird, 1843

Baird, 1843:91 (subgenus Camptocercus); 1850:128; Schoedler, 1863:3–35; Kurz, 1875:40; Hellich, 1877:75; Herrick, 1884:81 (subgenus Camptocercus); Lilljeborg, 1900:399–401; Bening, 1941:247, Figure 103; Brooks, 1953:149–150 (Acrokurzia); Šrámek-Hušek et al., 1962:316; Herbst, 1962:80; Manuilova, 1964:210–211.

Type species: Camptocercus rectirostris Schoedler, 1862.

Female. Baird (1843:91) stated that the body is oval and has a long, narrow, denticulate, very mobile postabdomen.

Posterodorsal corner of valves only slightly below highest point of dorsal margin. Distance between head pores and posterior margin of head shield shorter than distance between main pores. Valve with longitudinal lines. Antennules not reaching beyond apex of rostrum. Setae on antennae: 0–0–3/0–1–3. Postabdomen long, narrowing distally. Anus situated in proximal part of postabdomen. Anal denticles and lateral setae present. Claws long, with large basal spine and with setae on the concave part. Intestine forming loops, with a caecum. Ocellus smaller than eye.

Outer branch of endite of leg I with 3 setae, one of them shorter than the two others. Leg II with 8 hook-shaped setae and wide gnathobase. Leg III with a moderately large exopodite with 7 setae; seta 7 is the longest. Leg IV resembling leg III, exopodite of leg IV also moderately developed, with 7 setae. Exopodites of legs III and IV with 2 setae dorsally. Leg V with large oval exopodite with 4 setae, one of them anteriorly, the other three on the posterior side. We found a sixth leg in the form of a paired process on the ventral side of the abdomen in C. rectirostris.

Male. Vas deferens opening ventrally.

Key to Species of the Genus Camptocercus according to Females

1 (12). Head keel present.
2 (11). Antennules not reaching apex of rostrum.
3 (4). Rostrum pointed. Posteroventral corner of valves with denticles (not separated by free margin of valve) . . . . 1. C. rectirostris Schoedler, 1862.
4 (3). Rostrum blunt.
5 (6). Basal spine of claw widest in distal part. Posteroventral corner with separated denticles . . . . 2. C. fennicus Stenroos, 1898.
6 (5). Basal spine of claw widest in proximal part.
7 (10). Posteroventral corner of valve without denticles.
8 (9). Large setae on outer branch of endite of leg I with setules which gradually decrease in size distally . . . . 3. C. australis Sars, 1896.
9 (8). Large setae on outer branch of endite of leg I with a large hook-shaped proximal setule which forms a continuation of the base of the seta; the other part of the seta with setules is small . . . . 4. C. uncinatus sp. n.
10 (7). Posteroventral corner of valve with separated denticles . . . . 5. C. lilljeborgi Schoedler, 1862.
11 (2). Antennules projecting beyond apex of rostrum . . . . 6. C. rotundus Herrick, 1882.
12 (1). Head keel absent.
13 (14). Anal denticles large. Concave side of claw with a single larger denticle . . . . 7. C. aloniceps Ekman, 1900.
14 (13). Anal teeth small. Concave side of claw with numerous long spinules . . . . 8. C. oklahomensis Mackin, 1930.

Key to Species of Known Males of the Genus Camptocercus

1 (2). Claw of adult male S-shaped . . . . 1. C. rectirostris.
2 (1). Claw of adult male curved.
3 (4). Antennule projecting beyond apex of rostrum . . . . . 5. C. lilljeborgi.
4 (3). Antennule not projecting beyond apex . . . . 8. C. oklahomensis.

1. **Camptocercus rectirostris** Schoedler, 1862

Female. Posteroventral corner of valves with a varying number of denticles directed posterodorsally, the denticles usually apparently passing into each other (Figure 524). Number of teeth varying from 6 to 0 and 430 usually different on the right and left valve. Rostrum pointed, directed anteriorly or ventrally. Valves with curved stripes. Head keel present, passing into dorsal keel.

Head shield with 3 connected main pores, lateral pores usually situated opposite the median main pore (Frey, 1959). Antennules not reaching apex of rostrum. Antennules with sensory setae and esthetascs, 2 of the latter longer than the others. Antennae with two 2-segmented setae at base of proximal segment and with a spine in distal part of proximal segment. Setae on antennae: 0–0–3/0–1–3, spines: 1–0–1/0–0–1. Distal margin of segments of antennae with rows of small spinules. Plate of labrum with rounded apex.

Postabdomen long, narrow. Eleven to 17 denticles distal to the anus. Specimens with 18 anal denticles were described by Brehm (1912) as C. adhaerens. Sides of postabdomen with a row of small setae in groups of about 5. Anal margin with setae. Claw with a basal spine and a row of about 25 setae on the concave margin which become longer distally. Terminal seta larger than the others and followed by a row of hairs in $^2/_3$ of the remaining part (Frey, 1958). Intestine with a long caecum. Ocellus situated nearer to eye than to apex of rostrum.

Legs typical for the genus. Outer branch of endite of leg I with 3 setae of different length, the shortest seta half as long as the longest. The longest seta brushlike, the two shorter setae hook-shaped. Leg II with highly differentiated hook-shaped setae; setae 1, 2, and 3 pectinate with thin combs, seta 6 with thick denticles, setae 4, 5, 7, and 8 thin and relatively long. Legs III and IV of similar form. Endite of leg III with 7 hard setae in 2 groups. The group near the gnathobase consists of 4 thin setae of different lengths, the shorter setae situated near the interval between the two groups. The group near the exopodite consists of 2 hard pectinate setae and a feathered seta, which faces the interval between the two groups. Endite with 4 soft setae. Gnathobase with a filtering fan of 7 setae. Comparison with leg III illustrated by Lilljeborg (1900) permits us to add that the exopodite of this leg bears 7 setae. Leg VI in form of a short (paired) process, well distinguishable in live specimens.

There are forms in North America which do not agree with the above diagnosis of C. rectirostris (Frey, 1960:693, Plate I, Figures 7, 8); these forms should apparently be considered as different species.

Male. Maximum height before the middle. Posterodorsal corner of valves rounded. Posteroventral corner rounded, with denticles as in the female. Rostrum blunt. Antennules not reaching apex of rostrum.

Postabdomen long, narrowing distally, with numerous groups of lateral setae, without anal denticles. Preanal corner distinct. Claw S-shaped, with a basal spine and setae on the concave margin. Ocellus almost as large as eye. Vas deferens opening ventrally at base of claws. Length to 1 mm.

Juvenile male. Rostrum pointed. Postabdomen with anal denticles and groups of lateral setae. Claws curved, with a basal spine. Claws and basal spine with setae on the concave margin. Vas deferens opening ventrally, some distance from base of claws. Length 0.81 mm.

Key to Subspecies of C. rectirostris

1 (6). Concave margin of claw with a row of setae, with or without a distal spinule.
2 (5). Concave margin of claw with a row of setae without a large spinule on the distal end.
3 (4). Head keel gently sloping, rostrum directed anteriorly .... 1a. **C. rectirostris rectirostris** Schoedler, 1862.
4 (3). Head keel steeply sloping, rostrum directed ventrally .... 1b. **C. rectirostris biserratus** Schoedler, 1862.
5 (2). Concave margin of claw with a row of setae ending in large spinule on the distal end .... 1c. **C. rectirostris šiklejevi** Šrámek-Hušek, 1962.
6 (1). Concave margin of claw with a row of uniform large spinules .... 1d. **C. rectirostris serratunguis** Chiang Sieh-chih, 1964 comb. n.

1a. **Camptocercus rectirostris rectirostris** Schoedler, 1862 (Figures 523–529)

Fischer, 1851:188–189, Plate VIII, Figure 8, Plate IX, Figures 1, 2 (Lynceus macrourus); Schoedler, 1862:25, Plate II, Figure 43 (rectirostris); P. E. Müller, 1867:164–165, Plate III, Figure 12 (macrurus); 165, Plate II, Figure 19, Plate III, Figure 13 (rectirostris); Kurz, 1875:40–41; Lilljeborg, 1900:403–408; Plate LXI, Figure 14, Plate LXII, Figures 1–15 (rectirostris s.str., var.); Brehm, 1912:170, Figures 1, 2 (adhaerens); Herr, 1917:88–90; Brehm, 1928:318 (atavus); 1930:313–314, 320,
434 Figure 2 (caudatus); Bening, 1941:250, Figures 103a, b, c; Frey, 1959: 34, Figures 8–11; 1962a, Figures 8–11; Šrámek-Hušek et al., 1962:318, Figure 116 (var. rectirostris); Herbst, 1962:80, Figure 55.

Material. Numerous females from the Ivan'kovo, Uglich, Rybinsk, Cherepovets and Kama reservoirs, Sutka River (tributary of the Rybinsk Reservoir); several males from the Rybinsk and Cherepovets reservoirs and from Lake Diyaty (Vashutkiny Lakes, Arkhangel'sk Region). Preparations: MGU – female 562, male 1628. ZIN – female 53897 (548), male 53898 (1145).

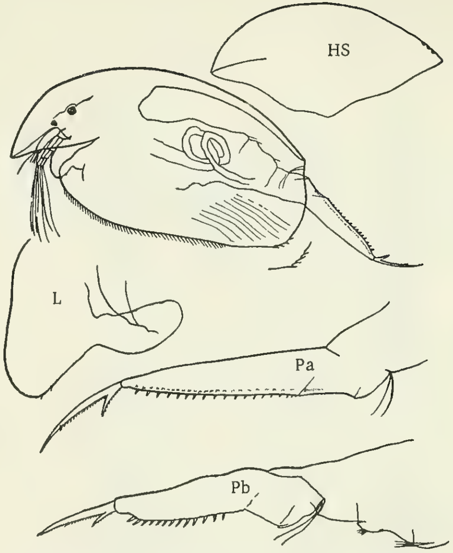

FIGURE 523. Camptocercus rectirostris rectirostris, female, length 0.95 mm (Il'd River, 10 August 1962):

L – labrum (Cherepovets Reservoir above Goritsy, 16 September 1963); HS – after Frey, 1962a; Pb – malformed postabdomen.

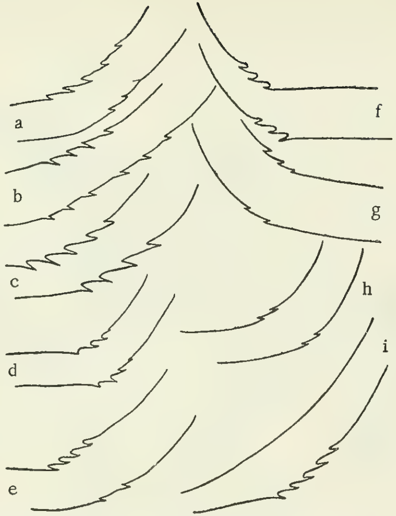

FIGURE 524. Denticles on posteroventral corner of valves of female of Camptocercus rectirostris rectirostris:

Top – left valve; bottom – right valve; a – Ivan'kovo Reservoir, 22 July 1962, preparation 556; b – Sutka River, 11 August 1962, preparation 557; Rybinsk Reservoir, Borok, 13 September 1961, preparation 559; d – same, preparation 565; e – Ivan'kovo Reservoir, 22 July 1962, preparation 551; f – Uglich Reservoir, mouth of Malaya Puditsa River, 23 July 1962, preparation 421; g – same, preparation 424; h – same, preparation 423; i – Rybinsk Reservoir, Borok, preparation 564.

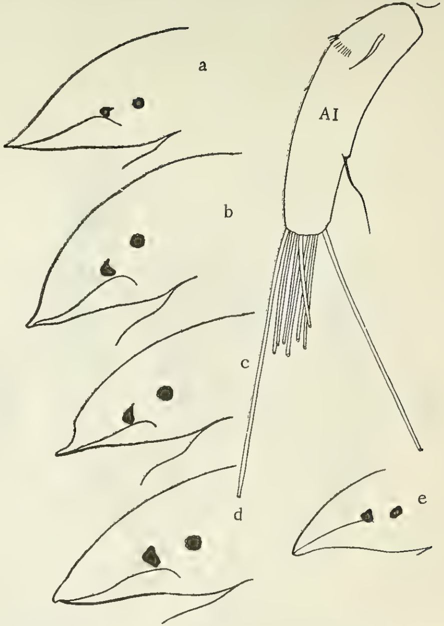

FIGURE 525. Camptocercus rectirostris rectirostris, female:

AI – left antennule, outer side (Cherepovets Reservoir above Goritsy, 16 September 1963). Rostrum: a – Rybinsk Reservoir, Borok, 13 September 1961, preparation 562; b – Ivan'kovo Reservoir, 22 July 1962, preparation 554; c – same, preparation 551; d – Sutka River, 11 August 1962, preparation 557; e – Uglich Reservoir, mouth of Malaya Puditsa River, 23 July 1962, preparation 425.

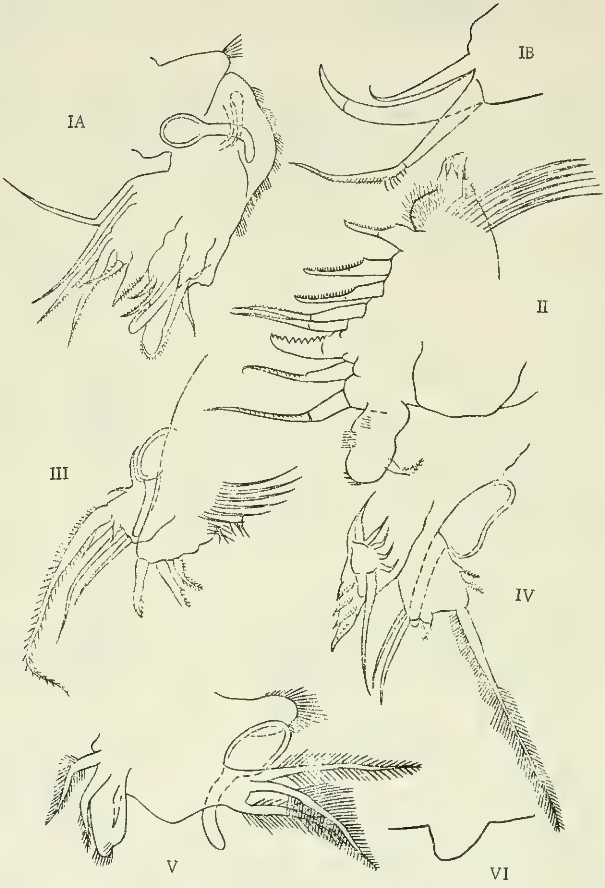

FIGURE 526. Legs of female of Camptocercus rectirostris rectirostris (Cherepovets Reservoir above Goritsy, 16 September 1963):

IA — right leg, outer side; IB — outer branch of endite, outer side; II, III — left legs, inner side; IV, V — right legs, inner side; VI — left leg, outer side.

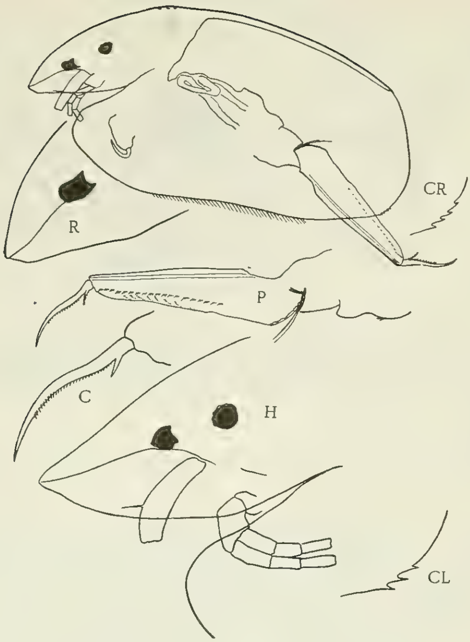

FIGURE 527. Camptocercus rectirostris rectirostris, male, length 0.83 mm:

R — Cherepovets Reservoir, Kolenets-Levinskoe, 6 September 1964, preparation 59; C — claw of male 0.88 mm long (Cherepovets Reservoir, 21 October 1963, preparation 1145); H — head of male 0.88 mm long; CL — posteroventral corner of left valve (Cherepovets Reservoir, mouth of Kovzha River, 10 September 1964, preparation 1628).

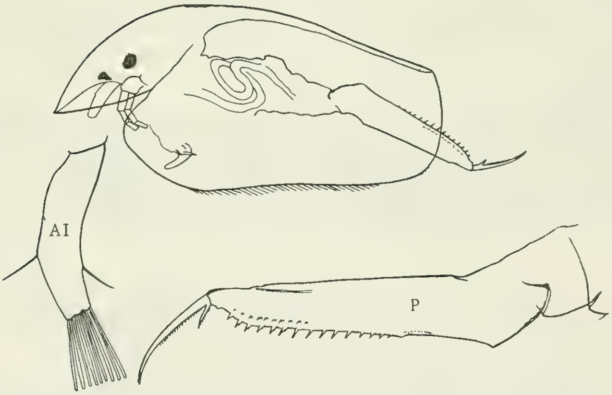

FIGURE 528. Camptocercus rectirostris rectirostris, juvenile male, length 0.81 mm (Rybinsk Reservoir, Borok, 20 October 1962):

P — postabdomen; AI — after Šrámek-Hušek et al., 1962.

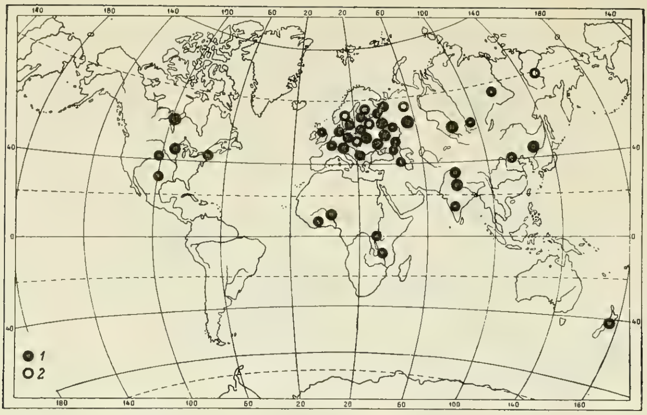

FIGURE 529. Distribution:

1 — Camptocercus rectirostris rectirostris; 2 — C. fennicus.

Female. Head with gently sloping dorsal keel; rostrum pointed, directed anteriorly. Postabdomen with 15—17 anal denticles. Posteroventral corner of valves with 3—5 denticles, concave margin of claw with a row of spinules of equal size (Šrámek-Hušek et al., 1962). Length, according to material from the Rybinsk Reservoir (13 September 1961) 0.72 (1st stage) to 1.26 mm, minimum length of gravid specimens 0.9 mm (3rd stage).

Distribution. Holarctic, Ethiopian, Indo-Malayan regions, New Zealand. European USSR, to the Lena basin and the southern Maritime Territory in the east.

1b. Camptocercus rectirostris biserratus Schoedler, 1862

Schoedler, 1862:25, Plate II, Figure 42 (biserratus); 1863:38, Plate II, Figure 42, Plate III, Figure 51 (biserratus); Lilljeborg, 1900:408—410, Plate LXII, Figures 16, 17 (var. biserratus); Shikleev, 1933:79, Figures 14, 15 (rectirostris var. abrau); Bening, 1941:251, Figure 103d; Šrámek-Hušek et al., 1962:318 (rectirostris var. biserratus); Manuilova, 1964:212.

Female. According to A. L. Bening (1941) head high, with a steep dorsal keel anteriorly; rostrum blunt, directed ventrally (cf. Figure 525). Posteroventral margin of valves with small spinules, rarely with a few denticles. Postabdomen with 12—16 anal denticles. Length of female to 1.15 mm.

Distribution. Europe, U.S.A.

1c. Camptocercus rectirostris šiklejevi Šrámek-Hušek, 1962

Šrámek-Hušek et al., 1962:318 (var. šiklejevi).

Female. Concave margin of claws with a row of spinules, one of them markedly larger than the others.

Distribution. Southeast Europe.

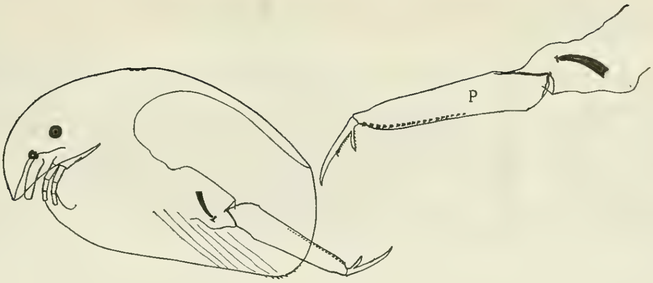

FIGURE 530. Camptocercus fennicus, female, length 0.55 mm (a lake near Pechora River, Lemtybozh, 12 August 1963, preparation 96)

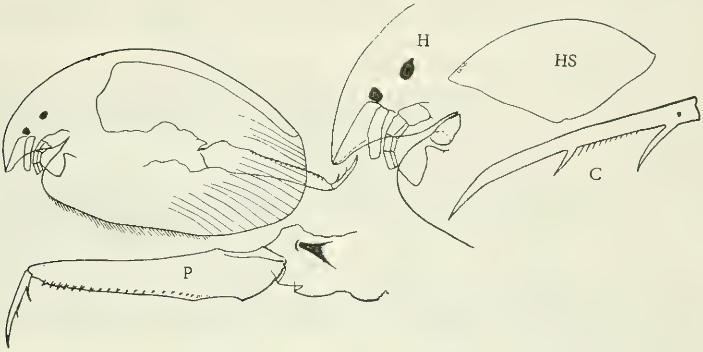

FIGURE 531. Camptocercus australis, female, length 0.66 mm (King Storm Dam, Australia, 9 February 1964, preparation 1788):

HS — after Goulden, 1966b.

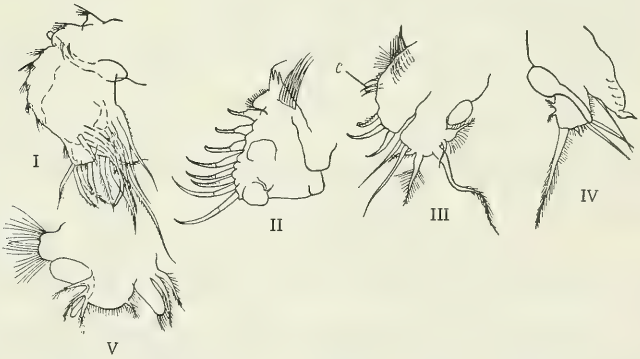

FIGURE 532. Legs of Camptocercus uncinatus, female (White Nile, Um Arda, 11 April 1964); I, V — right legs, inner side; II, IV — right legs, outer side; III — left leg, outer side.

1d. Camptocercus rectirostris serratunguis Chiang Sieh-chih, 1964 comb. n.

Chiang Sieh-chih, 1964:78–79, 88, Figures 17–20 (serratunguis).

Female. Posteroventral corner of valves with 4–5 denticles which appear to be passing into each other. Claw with a basal spine. Proximal $^{2}/_{3}$ of concave margin of claw with large spinules of equal size. Basal spine with setae on the concave side. Length about 1 mm.

Distribution. Sinkiang (China).

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2. Camptocercus fennicus Stenroos, 1898 (Figures 529, 530)

Lilljeborg, MS. 1880 (borealis); Stenroos, 1898:198, Plate III, Figures 19–24; Lilljeborg, 1900:412–413, Plate LXIII, Figures 1–5.

Material. Several females from the Komi ASSR. Preparation: MGU – female 96.

Female. Posteroventral corner of valves with denticles distinctly separated by parts of the margin. Ventral margin of valves with feathered setae, long setae from the anterior margin to the middle, increasing in size toward middle of valve and then short setae on the ventral and posterior margin. Valves with longitudinal lines. Rostrum pointed. Antennules almost reaching apex of rostrum, with 9 sensory papillae and a sensory seta laterally on each side in the middle. Two sensory papillae longer than the others. Distal segments of antennae reaching to apex of rostrum. Distal segments of both rami with a spine; the ramus with 3 setae has only a single spine on the basal segment. Both proximal segments with 2 transverse rows of setae.

Postabdomen with 19–20 anal denticles and a row of lateral groups of setae. Claws with a basal spine some distance from the base of the claws. Basal spine lanceolate, slightly widened apically. Claw and basal spine with setae on the concave margin. The setae on the claw increase in size to $^{2}/_{3}$ of the claw and are followed by a row of small setae which does not reach the apex. Length of female to 0.85 mm.

Male. Unknown.

Distribution. Palearctic. Northwest of European USSR, basin of rivers Pechora and Kolyma.

3. Camptocercus australis Sars, 1896 (Figures 531, 533, 534)

Sars, 1896b:45–47, Plate 6, Figure 910.

Material. Three females from Storm King Dam (Queensland); 2 females from New South Wales (Australia). Preparations: MGU – female 1788.

Female. Denticles on the rounded posteroventral corner of the valve absent. Posterodorsal corner distinct. Head keel present, passing into dorsal keel. Valve with longitudinal lines. Ventral margin of valve with setae in the middle. Rostrum blunt because the fornices converge only at the apex. Sars (1896b) described the rostrum as blunt, but it appears rather pointed in his Figure 9. Antennules not reaching apex of rostrum. Postabdomen with blunt preanal corner. Anal denticles about 20, decreasing in size proximally.

Length to 0.83 mm. The smallest female examined is 0.43 mm long.

Male. Valves with projecting posterodorsal corner. Posteroventral corner rounded. Rostrum blunt, directed anteriorly. Valves with longitudinal lines. Antennules slightly projecting beyond apex of rostrum. Plate of labrum with convex anterior margin.

Postabdomen with small anal setae and with groups of lateral setae. Vas deferens opening ventrally at base of claws. Claws with seta in proximal half of concave margin and with a basal spine. Length to 0.6 mm.

Megard (1967) considered C. australis as a separate species because of its distribution and thinks that further study will show new differences. We found that this species differs distinctly in the morphology of the first pair of legs, mainly of the outer branch of the endite.

Distribution. Australia. C. australis var. pavesii Bravo, 1918 was described from Italy.

4. **Camptocercus** uncinatus N. N. Smirnov, sp. n.
(Figures 128, 532)

Material. Numerous females from Lake Nikolaevskoe (Chita Region), from the White Nile near Um-Arda.

Holotype. MGU – female 2323.

Paratype. ZIN– female 2083.

Female. Maximum height slightly before middle of body. Dorsal margin of head and dorsal side of valves forming smooth curve. Posterior margin of valves curved, convex. Ventral margin of valve with setae. Posteroventral corner without denticles. Valves with moderately distinct longitudinal lines. Posterior margin of valves with 11–12 lines. Rostrum blunt since the fornices do not converge toward the apex. Antennules almost reaching apex of rostrum.

Postabdomen with distinct preanal corner; postanal corner absent. Anal denticles about 16, decreasing in size proximally; proximal denticles forming groups. Most anal denticles multicuspid. Claw with a denticle in middle of concave side, with row of setae proximally which decrease in size toward the base of the claw. Basal spine of claw tapering.

438 Ocellus situated slightly nearer to eye than to apex of rostrum.

Leg I with 3 setae on outer branch of endite, one of them short. The basal setule on both long setae is very large and hook-shaped. This setule forms a continuation of the base of the seta, the other part of the seta appears as an accessory flagellum. Length 0.76 mm.

Male. Unknown.

This species is distinguished by the following characters: the blunt, ventrally directed rostrum; the absence of denticles on the posteroventral corner of the valves; the large hook-shaped basal setule on the long setae on the outer branch of the endite of leg I. The absence of denticles on the posteroventral corner of the valve is a difference from C. rectirostris biserratus Schoedler, 1862.

(437)

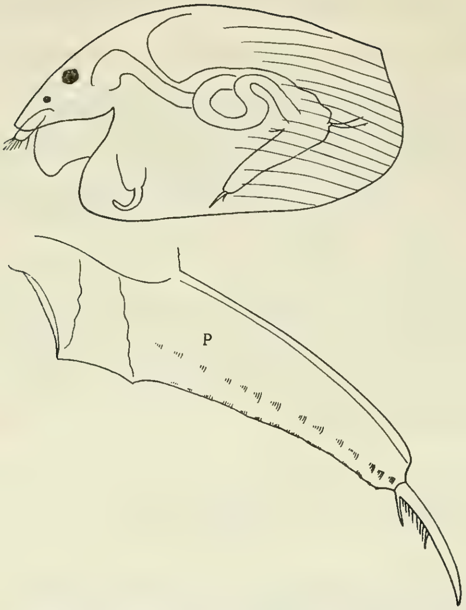

FIGURE 533. Camptocercus australis, male (after Daday, 1902)

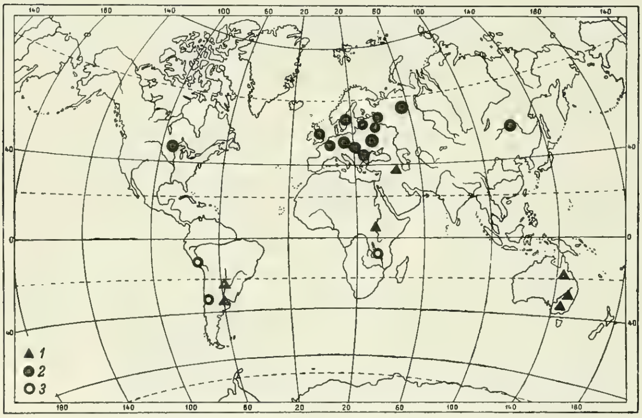

FIGURE 534. Distribution:

1 – Camptocercus australis + uncinatus; 2 – C. lilljeborgi lilljeborgi; 3 – C. aloniceps.

Distribution. Chita Region, White Nile.

5. **Camptocercus lilljeborgi** Schoedler, 1862

Female. Valves with distinct posterodorsal corner. Posteroventral corner with small denticles directed posterodorsally; denticles distinctly separated by areas of the margin and not passing into each other. The number of denticles varies from 2 to 5 and is often different on the right and left valves.

Key to Subspecies of C. lilljeborgi according to Females

1 (2). Claw with single denticle in middle of concave margin . . . . 5a. **C. lilljeborgi lilljeborgi** Schoedler, 1862.
2 (1). Claw with 3 denticles in middle of concave margin . . . . 5b. **C. lilljeborgi dadayi** Stingelin, 1913.

5a. **Camptocercus lilljeborgi lilljeborgi** Schoedler, 1862 (Figures 534–538)

Baird, 1843:91, Plate III, Figures 5, 6 (macrourus); 1850:128–129, Plate XVI, Figure 9 (macrourus); Lilljeborg, 1853:89–90, Plate VII, Figure 4 (Lynceus macrourus, ex parte); Schoedler, 1862:24, Plate III, Figures 46–48; P.E. Müller, 1867:166, Plate III, Figure 14; Kurz, 1874:43–44, Plate II, Figures 9, 10 (latirostris); Lilljeborg, 1900:413–416, Plate LXIII, Figures 6–13 (lilljeborgi); Daday, 1904a:64–66, Figure A, Plate 5, Figures 9, 10 (lilljeborgi); Šrámek-Hušek et al., 1962:320, Figure 117 (lilljeborgi); Herbst, 1962:80–82, Figure 56 (lilljeborgi); Manuilova, 1964:212–213, Figure 100 (lilljeborgi).

Material. Numerous females from the Ivan'kovo Reservoir, Sutka River (tributary of the Rybinsk Reservoir), Komi ASSR; one male from the Cherepovets Reservoir. Preparations: MGU – female 1020, 1019, 1011, 1016, 1025, 1020, 1023, male 1242. ZIN – female 53894 (1013). Ph – female 1022.

Female. Posteroventral corner of valves with 2 to 5 denticles, right and left valves often with a different number of denticles.

Distribution. Holarctic Region. European USSR, Amur basin.

5b. **Camptocercus lilljeborgi dadayi** Stingelin, 1913 (Figure 539)

Stingelin, 1913:620, 621, Figures 21, 22 (australis var. dadayi).

Material. Two females from Corrientes (Argentina). Preparations: MGU – female 2122. ZIN – female 2121.

Female. Posteroventral corner of valves with very small denticles. Antennules almost reaching apex of rostrum. Plate of labrum rounded.

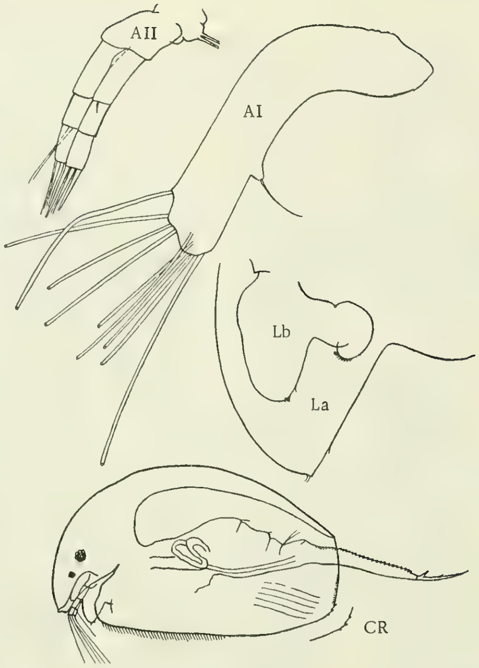

FIGURE 535. Camptocercus lilljeborgi lilljeborgi, female, length 0.88 mm:

AI — Il'd River, 10 August 1962; La — labral plate; Lb — labrum of another specimen (Sutka River, 11 August 1962); AII — left antenna, outer side (Sutka River, 11 August 1962).

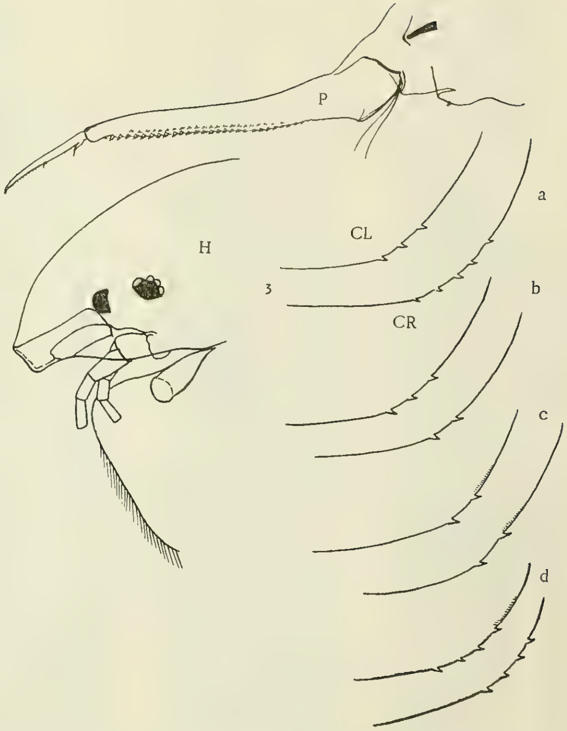

FIGURE 536. Camptocercus lilljeborgi lilljeborgi, female (Sutka River, 11 July 1962):

CV: a — preparation 1025; b — preparation 1020; c — preparation 1013; d — preparation 1023.

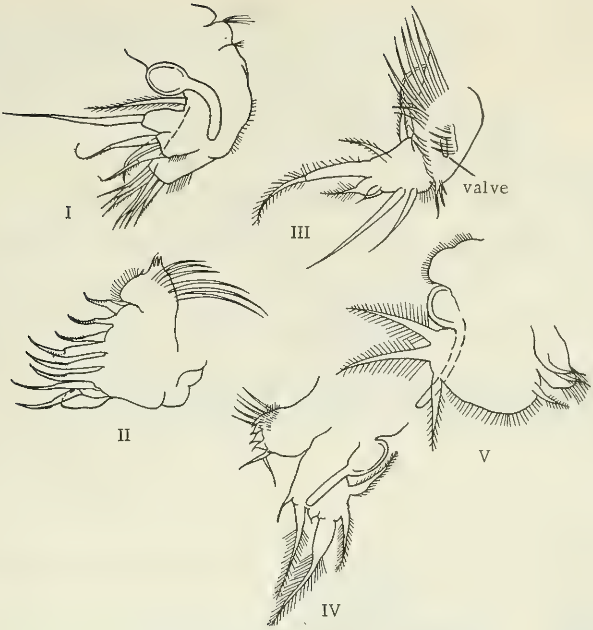

FIGURE 537. Legs of female of Camptocercus lilljeborgi lilljeborgi (Sutka River, 11 August 1962):

I – right leg, outer side; II, III, V – left legs, inner side; IV – left leg, outer side.

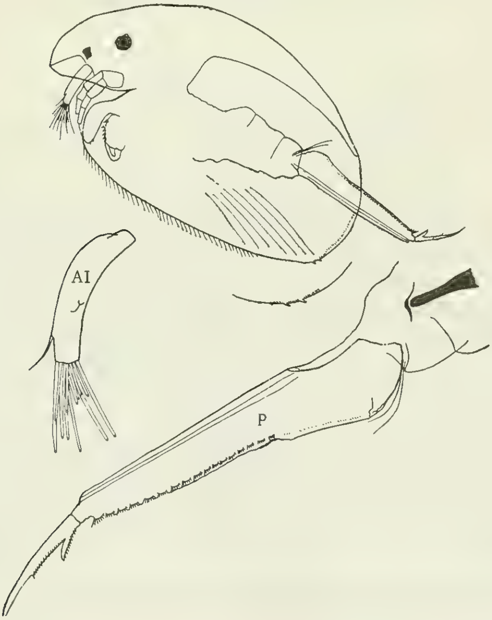

FIGURE 538. Camptocercus lilljeborgi lilljeborgi, male, length 0.65 mm (Cherepovets Reservoir, 16 September 1963, preparation 1242)

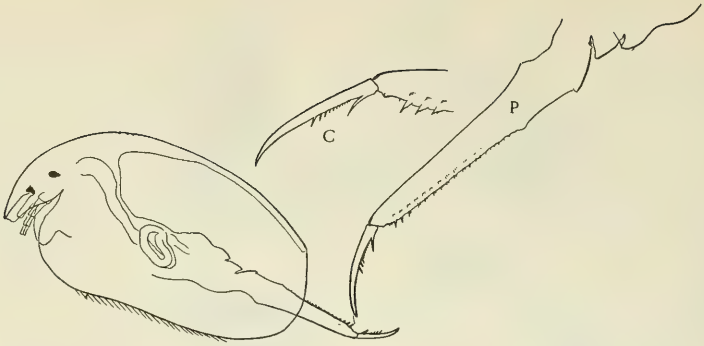

FIGURE 539. Camptocercus lilljeborgi dadayi, female, length 0.79 mm (Corrientes, Argentina, January 1967, preparation 2122)

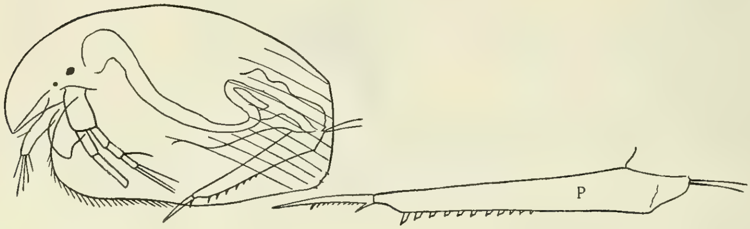

FIGURE 540. Camptocercus rotundus, female (after Herrick, 1882)

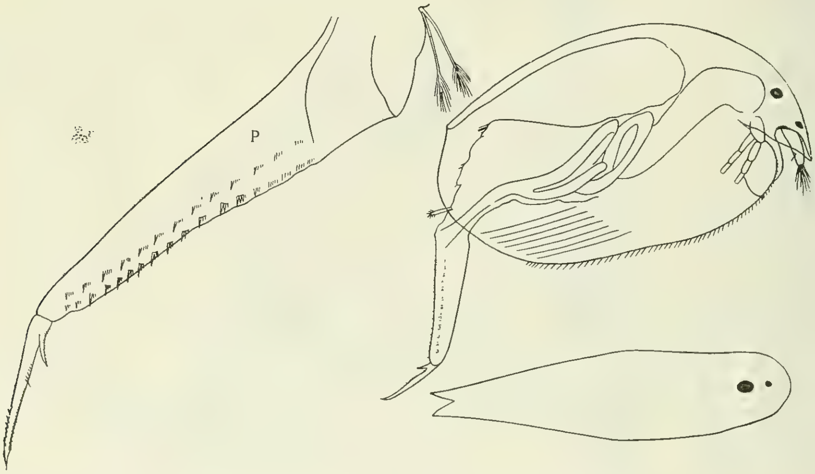

FIGURE 541. Camptocercus aloniceps, female (after Ekman, 1900)

Postabdomen with projecting preanal corner. About 11 anal denticles. Groups of lateral setae present. Claws with 3 spines on the concave margin. Ocellus slightly smaller than eye, situated in middle between eye and apex of rostrum. Length 0.7 mm.

Distribution. Columbia, Corrientes (Argentina).

6. **Camptocercus rotundus** Herrick, 1882 (Figure 540)

Herrick, 1882:249, Plate VIII, Figures 9, 10; 1884:84–85.

Material. According to description.

Female. Posteroventral corner with denticles. Valves with longitudinal lines. Rostrum pointed. Antennules distinctly longer than rostrum. Postabdomen with about 11 anal denticles. Claws with a row of setae on the concave margin which does not reach the apex; setae decreasing in size proximally. Length 0.7 mm.

Male. Unknown.

Distribution. Minnesota.

7. **Camptocercus aloniceps** Ekman, 1900 (Figures 534, 541, 542)

Ekman, 1900:75–78, Plate 4, Figures 21–24; Brady, 1913:468–469, Plate XXXVIII, Figure 1; Delachaux, 1919:28–29, Plate II, Figures 1–3 (naticochensis).

442

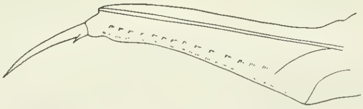

FIGURE 542. Camptocercus aloniceps, postabdomen of male (after Ekman, 1900)

Material. According to description.

Female. According to Ekman (1900) a head keel is absent, and the eye and ocellus are therefore situated on the margin of the head. Denticles on posteroventral corner of valve absent. Valves with longitudinal lines and dots between them. Antennules reaching apex of rostrum with a lateral seta. Antennae with 4 setae on the endopodite. Distal segments of both rami with 3 setae and a spine.

Postabdomen with 16–19 groups of denticles which consist of 1–2 large distal denticles and 1–3 setae. Proximal groups consisting only of setae. Lateral row of groups of setae present. Claws with a basal spine. Concave margin of claw and basal spine with setae, 1–2 larger setae situated slightly proximal to the middle of the claw. Intestine forming loops, with a caecum. Ocellus situated halfway between eye and apex of rostrum. Length to 0.75 mm.

Male. Vas deferens opening ventrally at base of claws. Anal denticles represented by setae; lateral groups of denticles present. Claw with a basal spine.

Distribution. Africa, South America.

8. Camptocercus oklahomensis Mackin, 1930
(Figures 543, 544)

Mackin, 1930:46, Plate 7, Figures 1, 2, 3; Brooks, 1953:149–150, Figures A, B (Acrokurzia lateralis); Harding, 1955:341, Figures 46, 47, 48.

Material. Four females from a pond in Illinois, U.S.A. Preparation. MGU – 4 females 2532.

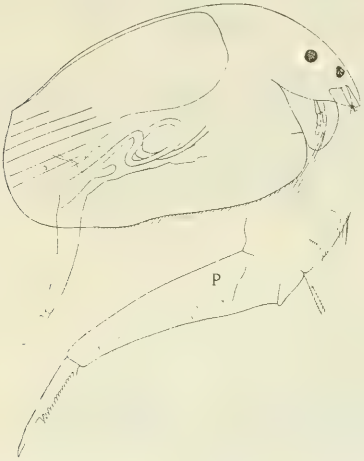

FIGURE 543. Camptocercus oklahomensis, female (after Mackin, 1930)

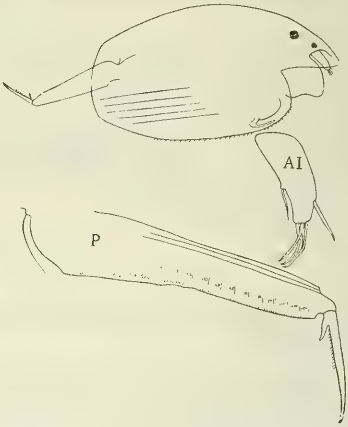

FIGURE 544. Camptocercus oklahomensis, male (after Mackin, 1930)

Female. Maximum height in anterior half of body. Valves with longitudinal lines. Head keel absent. Posteroventral corner rounded, without denticles, with small spinules. Antennules with a sensory seta on the posterior margin. Setae on antennae: 0–1–3/0–0–3.

Postabdomen with distinct preanal corner. Anal denticles very small, 45–65 altogether. Lateral setae in 15–17 groups. Several groups outside this row proximally. Claw with a basal spine with setae in proximal part. Concave margin of claw with a row of 9–15 spinules which increase in size distally and extend from the basal spine slightly beyond the middle of the claw. A row of setae on the concave margin distally. Abdomen segmented near postabdomen, 2 posterior segments with long setae on the dorsal side. Rows of setae continuing on lateral parts of segments but with smaller setae.

443 According to Harding (1955) the concave margin of the claw of the female bears setae which decrease in size proximally. Intestine forming loops, with a caecum. Eye situated less than its width from margin of head. Ocellus situated halfway between eye and apex of rostrum. Length to 1 mm.

Male. Posteroventral corner of valves rounded, without denticles. Valves with lines. Rostrum blunt. Antennules reaching apex of rostrum. Dorsal margin of postabdomen with fine hairs only. Lateral groups of setae present. Vas deferens opening near base of claws, ventral to them. Claw with a basal spine. Ocellus smaller than eye. Length 0.6 mm.

Distribution. U.S.A.

Species incertae sedis

Camptocercus macrourus (O. F. Müller, 1785).

O. F. Müller, 1785:77, Plate X, Figures 1–4 (Lynceus macrourus); Lilljeborg, 1900:410–411, Plate LXII, Figure 18 (macrourus); Herr, 1917:90–92, Figure 28; Šrámek-Hušek et al., 1962:320–321.

Camptocercus oklahomensis Brehm, 1959b:6–7, Figure 5.

Camptocercus polyodontus Werestschagin, 1912:173–175, Figures 6–7.

Camptocercus rectirostris Chiang Sieh-chih, 1964:78, Figures 14, 15, 16.

The denticles on the posteroventral corner of the valve are very small and separated or absent so that this form cannot be placed in C. rectirostris as defined here.

Camptocercus rectirostris Frey, 1960:693, Plate I, Figures 7, 8.

The posteroventral corner of the valve bears denticles which are separated by areas of the curved margin in contrast to the European type form examined. This character and the blunt rostrum resemble that of C. lilljeborgi.

Camptocercus rectirostris var. lencoranica Zhuze, 1929: 124–125, Figures 3–4. The morphology of the legs has not been described.

Camptocercus similis Sars, 1901:89–91, Plate XII, Figures 4, 4a. The morphology of the legs has not been described. The systematic position of this form can therefore not be determined.

17. Genus Graptoleberis Sars, 1862.

Fischer, 1851:191 (Lynceus, part); Sars, 1862a:41; Schoedler, 1863 (Alona); Kurz, 1875:60; Herrick, 1884:89; Lilljeborg, 1900:502–504; Sars, 1901:65–66; Daday, 1910b:127; Bening, 1941:263; Šrámek-Hušek et al., 1962:358; Herbst, 1962:90–92; Manuilova, 1964:218.

Type species: Graptoleberis testudinaria (Fischer, 1851).

Female. Body with semicircular outline. Posteroventral corner of valves usually with denticles. Rostrum wide, spatula-shaped. Head shield with pointed posterior margin. Distance between main head pores longer than distance from pores to posterior margin of head shield. Reticulation consisting of distinct large cells. Antennules not reaching apex of rostrum. Setae on antennae: 0–0–3/0–1–3. Plate of labrum rounded. Postabdomen narrowing distally. Claws short, with one basal spine. Vas deferens opening ventrally at base of claws. Ocellus smaller than eye.

Six pairs of legs. Leg I strongly modified. Outer branch of endite separated by a deep incision and with 2 large pectinate setae and a small hook-shaped seta. Anterior side of endite with a feathered appendage dorsally. Leg II with markedly differentiated hook-shaped setae. Legs III and IV with well developed exopodites. Leg V with small exopodite with 4 setae. Leg VI in form of a small process (paired, like the other legs).

Male. Smaller than female, with modified leg I. Only one species.

1. Graptoleberis testudinaria (Fischer, 1851)

Negrea, 1966a:145.

Female. Dorsal margin convex, ventral margin almost straight. Ventral margin of rostrum at level of ventral margin. Ventral margin of valves with feathered setae which decrease in size toward the posteroventral corner but do not reach it. Posteroventral corner of valves with denticles; they may be of different number on the left and right valve, or absent. Number of denticles 5 (Sklyarova, 1947). Gauthier (1928b, Figure 29D) illustrated a specimen from North Africa with 4 denticles on the left valve.

Lateral keel weakly developed, extending from apex of rostrum to below the ocellus above the base of the antennae. Head and valves with tetragonal, pentagonal or hexagonal cells. Rostrum very wide. Head shield with angular posterior margin.

444 According to Frey (1959) the lateral pores are situated at the level of the median main pore and surrounded by a chitinous ring. Three connected main head pores. Examination from in front shows that the ventral margins of the valves diverge in the middle, forming a wide sole. Antennules with a sensory seta at the distal end of the anterior margin; distal end with esthetascs of different length. Plate of labrum with rounded apex.

Postabdomen with distinct preanal corner. Anal margin with setae in distal part. Dorsal margin of postabdomen with a row of anal denticles which slightly increase in size distally. Postabdomen with a row of 6–8 groups of setae laterally. Claws with a row of setae on the concave margin. Claws laterally with 2 diagonal rows of setae ending on the convex side. In the specimens collected by Veisig (1931) in the Caucasus, the claws had no basal spine. Our illustration shows the position of the brood chamber of G. testudinaria more exactly. The dorsal margin of the valves is distinctly displaced ventrally by the dorsal keel. Lilljeborg (1900) and Šrámek-Hušek et al. (1962) illustrate the dorsal margin of the brood chamber too close to the dorsal margin of the valves.

Legs strongly modified. Outer branch of endite of leg I deeply separated, with 2 brushlike and a short hook-shaped setae. Anterior side of endite with a characteristic feathered process in the proximal part. Leg II with highly differentiated hook-shaped setae. Leg V with a small exopodite.

Male. Height less than in female. Posteroventral corner of valves with denticles. Postabdomen narrowing distally, without anal denticles. Antennules not reaching apex of rostrum. Claws without basal spine. Vas deferens opening ventrally at base of claws. Ocellus smaller than eye. Length to 0.5 mm.

Outer branch of endite of leg I with a hook, 2 brushlike setae and a thin seta which is $^{2}/_{3}$ as long as the brushlike setae.

Key to Subspecies of G. testudinaria according to Females

1 (6). Postabdomen narrowing distally.
2 (5). Claw with a single basal spine.
3 (4). Posteroventral corner of valve with large denticles . . . .
. . . . 1a. **G. testudinaria testudinaria** (Fischer, 1851).
4 (3). Posteroventral corner of valve with small denticles . . . .
. . . . 1b. **G. testudinaria occidentalis** Sars, 1901.
5 (2). Claw with 3 basal spines . . . .
. . . . 1c. **G. testudinaria slovenica** Šrámek-Hušek, 1962.
6 (1). Postabdomen only slightly narrowing distally.
7 (8). Claw with denticles on the convex margin . . . .
. . . . 1d. **G. testudinaria pannonica** Daday, 1904.
8 (7). Claw without denticles on the convex margin . . . .
. . . . 1e. **G. testudinaria orientalis** Daday, 1910.

1a. Graptoleberis testudinaria testudinaria (Fischer, 1851) (Figures 545–549)

Baird, 1843:93, Plate III, Figure 12 (Alona reticulata); 1850:132–133, Plate XVI, Figure 3 (A. reticulata); Fischer, 1851:191, Plate IX, Figure 12 (Lynceus testudinarius); Schoedler, 1858:28 (Alona esocirostris); Leydig, 1860 (Lynceus reticulatus); Sars, 1862a:53 (reticulata); Schoedler, 1862:24 (Alona reticulata), 24, Plate I, Figures 26, 27 (A. esocirostris); Kurz, 1875:60, Plate II, Figures 11, 12; Hellich, 1877:96, Figure 54 (A. testudinaria); Birge, 1879:26–28, Plate I, Figure 17 (inermis); Herrick, 1882:250, Plate X, Figures 8, 11, 12 (inermis); Sars, 1891:13; Stingelin, 1895:252; Lilljeborg, 1900:504–509, Plate LXXI, Figures 9–14, Plate LXXII, Figures 1–8 (testudinaria); Henry, 1922:43, Plate VI, Figure 5, 5a; Bergamin, 1941:164–165 (testudinaria); Bening, 1941:263–266, Figure 109 (testudinaria); Frey, 1959: 36, Figures 38–39; 1962a, Figures 38, 39 (testudinaria); Šrámek-Hušek et al., 1962:360, Figure 134A (var. testudinaria); Herbst, 1962:92, Figure 73 (testudinaria); Goulden, 1966b:94–96, Plate I, Figure 14 (testudinaria typica).

Material. Numerous females from the Rybinsk and Cherepovets reservoirs, the Komi ASSR; one female from the Uglich Reservoir and the Shavkunovskii pond in the Perm Region; several females from Lake Goloustnoe on the west shore of Lake Baikal. Numerous males from the Rybinsk and Cherepovets reservoirs. Preparations: MGU – female 589, male 582. ZIN– female 591, male 593.

Female. The ventral denticle on the posteroventral corner of the valves is more than 8μ long (Bär, 1924). Posteroventral corner of valves with a varying number of denticles (Figure 545). Postabdomen tapering distally. In the female of preparation 589, the dorsal and ventral denticles on the posteroventral corner of the valves are 12 and 14μ long.

Distribution. Cosmopolitan.

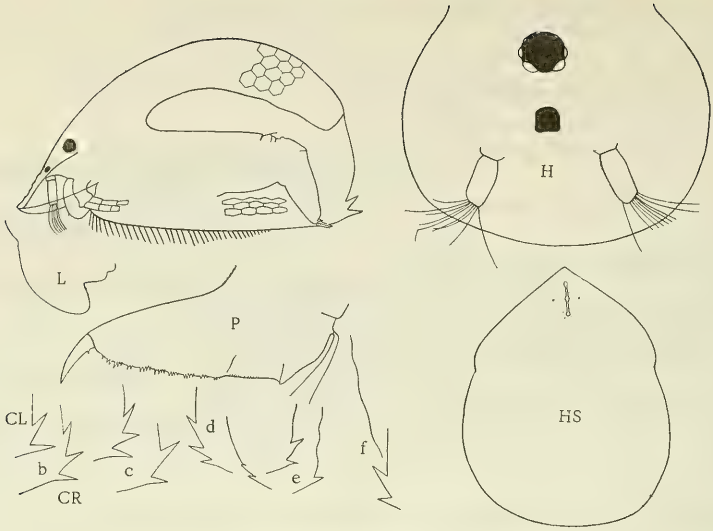

FIGURE 545. Graptoleberis testudinaria testudinaria, female, length 0.55 mm (Il'd River, 10 August 1962):

CV: b – Rybinsk Reservoir, Borok, 24 July 1961, preparation 973; c – same, preparation 970; d – Cherepovets Reservoir, 16 September 1963, preparation 580; e – same, preparation 570; f – same, preparation 596; L – same, preparation 589; H – Cherepovets Reservoir, Goritsy, 10 September 1963; HS – after Frey, 1962a.

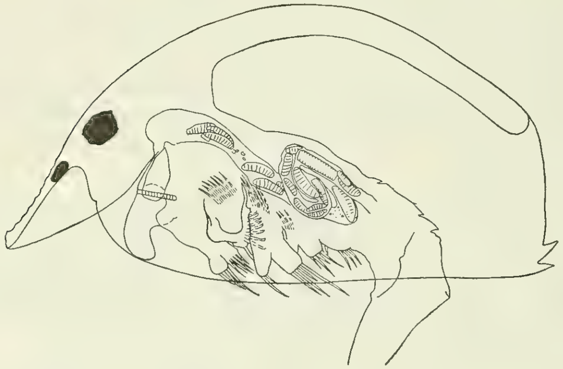

FIGURE 546. Graptoleberis testudinaria testudinaria, female, intestine filled with diatoms, mainly Epithemia (Cherepovets Reservoir, Goritsy, 16 September 1963, preparation 589)

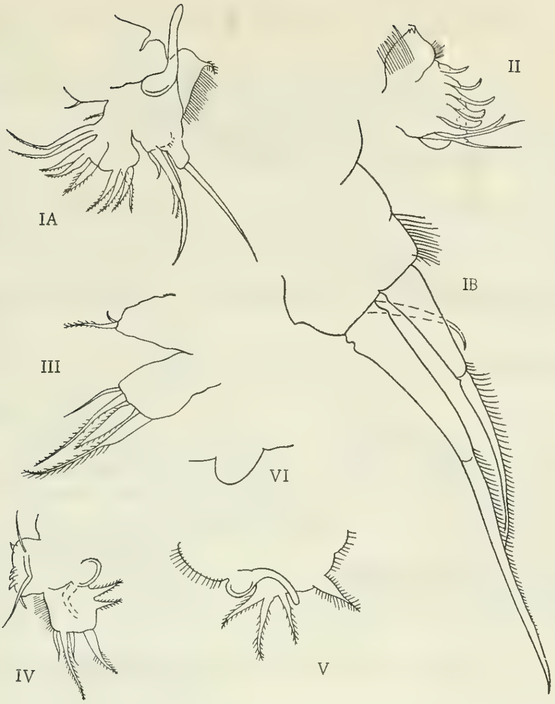

FIGURE 547. Legs of female of Graptoleberis testudinaria testudinaria (Cherepovets Reservoir, Goritsy, 16 September 1963):

IA, V – right legs, outer side; IB – outer branch of endite, outer side; II, IV – right legs, inner side; III, VI – left legs, outer side.

1b. **Graptoleberis testudinaria occidentalis** Sars, 1901 (Figure 550)

Sars, 1901:66, Plate X, Figures 8, 8a, 8b (var. occidentalis); Goulden, 1966b:94–96, Plate I, Figures 12, 13.

Material. Numerous females from New South Wales, Australia. Preparations: MGU – female 2137, 2138, 2153. ZIN – female 2142.

Female. Posteroventral corner of valve with 2 small denticles; there are usually 2 denticles (preparations 2137, 2138, 2142), sometimes 3 on the left and 2 on the right valve (preparation 2153). The ventral and dorsal denticles on the posteroventral corner of the valve are 7–9 and about 10μ long. In the specimens from New South Wales the postabdomen tapers distally so that the dorsal margin is straight or slightly concave. Anal denticles in groups of 3 or 4. Preanal corner blunt, not strongly projecting. Anal margin slightly concave. Claws with a small basal spine. Claw with 2 spinules on the convex margin and with setae on the concave margin. The intestine was filled with large diatoms in one specimen (preparation 2137).

Distribution. São Paulo (Brazil), Ellabong Lagoon (New South Wales, Australia).

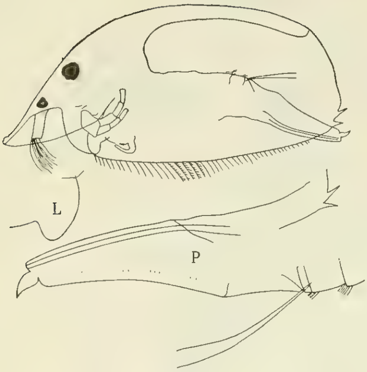

FIGURE 548. Graptoleberis testudinaria testudinaria, male, length 0.46 mm (Cherepovets Reservoir, Goritsy, 16 September 1963):

L – preparation 582.

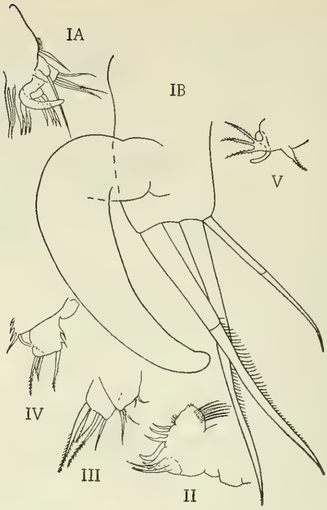

FIGURE 549. Legs of male of Graptoleberis testudinaria testudinaria (Cherepovets Reservoir, Goritsy, 16 September 1963):

IA, II – right legs, outer side; IB – outer branch of endite, outer side; III, V – left legs, inner side; IV – right leg, inner side.

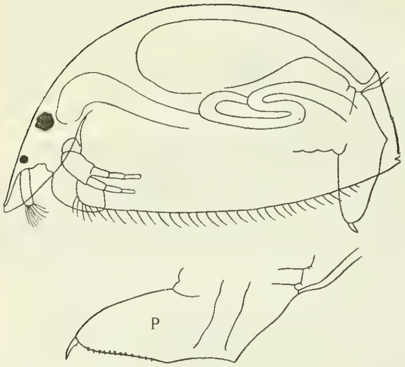

FIGURE 550. Graptoleberis testudinaria occidentalis, female (after Sars, 1901)

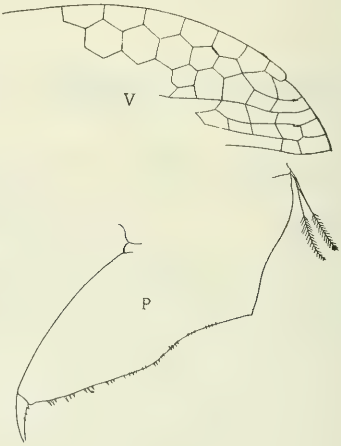

FIGURE 551. Graptoleberis testudinaria slovenica, female (after Šrámek-Hušek et al., 1962)

1c. **Graptoleberis testudinaria slovenica** Šrámek-Hušek, 1962 (Figure 551)

Šrámek-Hušek et al., 1962:360, Figures 134E, F (var. slovenica).

Female. Anal denticles in groups of 3–5. Claw with a basal spine and with 2 setae resembling the spine on the concave margin, with fine hairs further on.

449 Distribution. Czechoslovakia.

1d. **Graptoleberis testudinaria pannonica** Daday, 1904 (Figure 552)

Daday, 1904a:59, Plate 5, Figures 3, 4 (var. pannonica); Bening, 1941: 365; Šrámek-Hušek et al., 1962:360.

Female. Posteroventral corner of valve with to 5 large denticles. Postabdomen slightly tapering distally. Anal denticles situated not on dorsal margin of postabdomen but laterally in curved groups. Claw without basal spine and with smooth concave margin; convex margin with 4 denticles. Length 0.53 mm.

Distribution. Hungary. USSR: upper reaches of the Don.

1e. **Graptoleberis testudinaria orientalis** Daday, 1910 (Figure 553)

Daday, 1910b:127–128, Plate 6, Figure 29 (var. orientalis); Bär, 1924:112–114, Figure 10 (var. orientalis).

Female. Posteroventral corner of valves with a ventral denticle 4.2 μ long (Bär, 1924). According to Daday (1910b), anal denticles large, 6–7 altogether, decreasing in size proximally, the 3 distal denticles isolated, the following accompanied by 1–3 setae. Claw without basal spine, with a denticle in distal part of convex side. Bär (1924) described under this name a new variety of this species in which the postabdomen also tapers only slightly distally and bears 6 separated spinules. Anal margin with setae, preanal corner strongly projecting. In the drawing of Bär, there are no denticles or spines on the convex or concave side of the claw. Length 0.55 mm.

These forms are placed in the same subspecies because of similar form of the postabdomen and the anal denticles as described by the two authors.

Distribution. Ceylon, Lake Nyasa.

Nomina nuda

Graptoleberis wojnowiensis Dybowski and Grochowski, 1895:151. Nomen nudum.

Graptoleberis wojnowiensis var. anacanthina Dybowski and Grochowski, 1895:151. Nomen nudum.

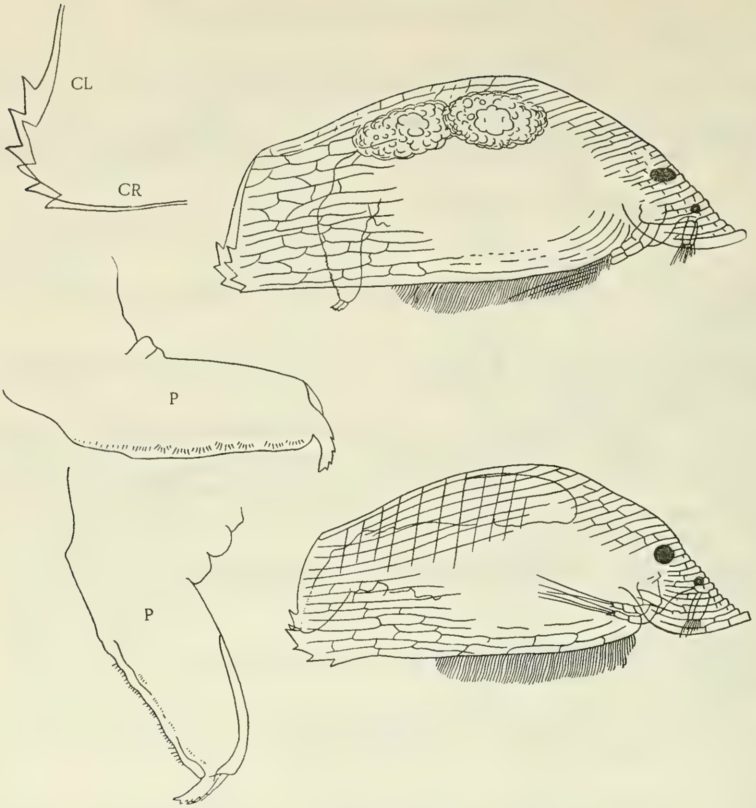

FIGURE 552. Graptoleberis testudinaria pannonica, female (floodplain of upper reaches of the Don, Lake Seleznevoe, Pavlovsk District). Drawing by T.V. Sklyarova.

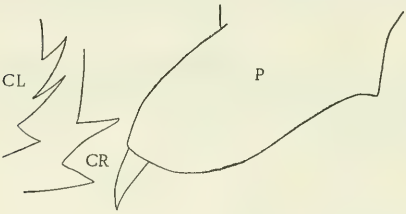

FIGURE 553. Graptoleberis testudinaria orientalis, female (after Bär, 1924)

18. Genus Leydigia Kurz, 1875

Fischer, 1854:431 (Lynceus, part); Schoedler, 1858 (Alona); 1862 (Eurycercus); Kurz, 1875:57; Hellich, 1877:88; Herrick, 1884:88; Lilljeborg, 1900:492–493; Cosmovici, 1900 (Chydorus); Daday, 1910b: 136; Sars, 1916:328; Bening, 1941:287; Šrámek-Hušek et al., 1962:354; Herbst, 1962:90.

Type species: Leydigia leydigi (Schoedler, 1863).

Body oval. Posterodorsal corner of valve near level of highest point of dorsal margin. Ventral margin of valves convex. Rostrum short, blunt. Head shield with rounded posterior margin. Main head pores connected. Distance from head pores to posterior margin of head shield longer than distance between main pores. Setae on antennae: 0–0–3/1–1–3. Some segments of antennae with groups of spines. Plate of labrum rounded. Postabdomen wide, flattened. Anal denticles very small. Groups of lateral setae well developed. Claw with a small basal spine or without spine.

Leg I with row of setae on anterior side of endite. Exopodite with a very long seta. Leg II with very long seta 8. Leg III with exopodite with 5 setae, 2 on the posterior side and 3 on the dorsal side. Leg IV with rounded exopodite with 6 setae. Leg V very large, with an exopodite with 4 feathered setae.

Male smaller than female, with modified leg I and postabdomen. In the adult male the vas deferens opens at the end of a penislike distal appendage of the postabdomen.

Key to Species of the Genus Leydigia according to Females

1 (22). Sides of postabdomen without continuous row of long setae.
2 (21). Anterior margin of labrum smooth, without groups of setae.
3 (6). Claw with a basal spine.
4 (5). Ocellus slightly larger than eye . . . 1. L. leydigi (Schoedler, 1863).
5 (4). Ocellus 3 times as large as eye . . . . 2. L. macrodonta Sars, 1916.
6 (3). Claw without basal spine.
450 7 (20). Postabdomen not narrowing distally, widest in distal part.
8 (15). Row of groups of lateral spines not continuing proximally into a row of isolated spines.
9 (12). Distal groups of lateral setae with more than 2 setae. Valves granulate or punctate, without longitudinal lines.
10 (11). Valve with longitudinal rows of granules . . . . 3. L. ciliata Gauthier, 1939.
11 (10). Valve punctate . . . . 4. L. laevis Gurney, 1927.
12 (9). Distal groups of lateral setae with 2 setae. Valves with longitudinal lines.
13 (14). Eye slightly smaller than ocellus . . . . 5. L. acanthocercoides (Fischer, 1854).
14 (13). Eye several times smaller than ocellus. . .6. L. microps Sars, 1916.
15 (8). Row of groups of lateral spines passing proximally into a row of isolated spines.
16 (17). 6–7 isolated spines . . . . 7. L. propinqua Sars, 1903.

17 (16). 15–16 isolated spines.
18 (19). Dorsal margin convex. Valves with concentric lines . . . . 8. L. schubarti Brehm and Thomsen, 1936.
19 (18). Dorsal margin straight. Valves with indistinct longitudinal lines . . . . 9. L. trichura Fordyce, 1904.
20 (7). Postabdomen slightly narrowing distally, widest in the middle . . . . 10. L. australis Sars, 1885.
21 (2). Anterior margin of labrum undulate, with groups of setae on processes . . . . 11. L. ipojucae Brehm, 1938.
22 (1). Sides of postabdomen with a continuous row of long setae . . . . 12. L. fimbriata Fordyce, 1901.

Key to Adequately Described Males of Leydigia

1 (10). Dorsal margin of postabdomen convex.
2 (7). Antennules shorter than rostrum.
3 (4). Claw with a basal spine . . . . 1. L. leydigi.
4 (3). Claw without basal spine.
5 (6). Ocellus larger than eye . . . . 3. L. ciliata.
6 (5). Ocellus and eye of equal size . . . . 4. L. laevis.
7 (2). Antennules reaching apex of rostrum.
8 (9). Postabdomen not narrowing distally, widest in distal part . . . . 5. L. acanthocercoides.
9 (8). Postabdomen slightly narrowing distally, widest in the middle . . . . 10. L. australis.
10 (1). Dorsal margin of postabdomen slightly concave . . . . 6. L. microps.

1. Leydigia leydigi (Schoedler, 1863) (Figures 521, 554–559)

Schoedler, 1858, 1860, 1863:27 (Alona leydigii); Leydig, 1860:221–223, Plate VIII, Figure 59 (Lynceus quadrangularis); Kurz, 1875:58–59, Plate II, Figure 2 (quadrangularis); Matile, 1890:42, Figure 29 (Alona); Stingelin, 1895:243–244 (Alona leydigii); Lilljeborg, 1900: 494–499, Plate LXX, Figures 6–17, Plate LXXI, Figures 1–3 (quadrangularis); Daday, 1902:265–266, Plate 6, Figure 1; Methuen, 1910:157, Plate XVI, Figure 43 (trispinosa); D'Ancona, 1933:47–48, Figures 5–8 (quadrangularis); Bening, 1941:288–290, Figure 119; Motas and Orghidan, 1948:128, Figure 7; Frey, 1959:37, Figures 15–18; 1962a, Figures 15–18; Šrámek-Hušek et al., 1962:355–356, Figure 132; Herbst, 1962:90, Figure 71; Chiang Sieh-chih, 1964:83, Figure 25; Negrea, 1966a:144.

Material. Numerous females from the Ladka River (tributary of the Rybinsk Reservoir); one female from the Kalininskii pond in the Perm Region; several females from ponds on the Yakot' fish farm, from Lake Karmak-Kul' in the Aktyubinsk Region; several males from the Ladka River. Preparations: MGU – female 436, females with modified postabdomen 1077, 1360, male 435, juvenile male 444. ZIN – female 446, male 462. Ph – female 440.

(451)

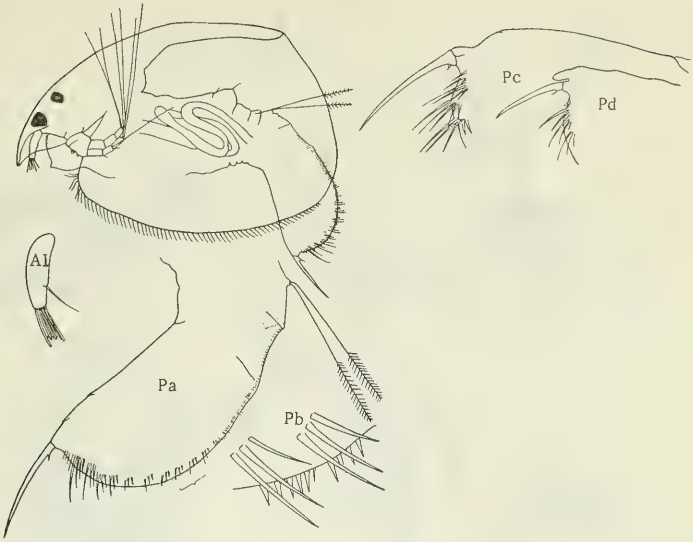

FIGURE 554. Leydigia leydigi, female, length 0.74 mm (Ladka River, 14 August 1964):

Pa, Pb — postabdomen and two groups of anal denticles and lateral setae, high magnification (preparation 436); Pc — modified postabdomen (Ladka River, 14 August 1962, preparation 1077); Pd — modified postabdomen (Lake Karmak-Kul', Aktyubinsk Region, 15 August 1965, preparation 1360).

Female. Posterodorsal corner at level of dorsal margin of valve. Posterior margin with marginal row of small spinules on the inner side. Ventral margin with feathered setae, longer setae in the posterior half. Valves with lines or granulate. Rostrum blunt. Head shield with rounded posterior margin.

(451)

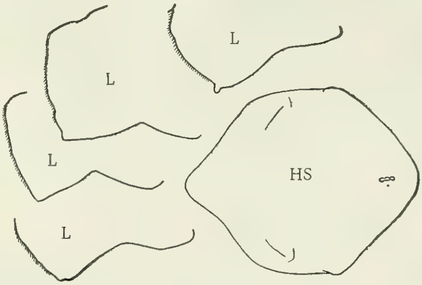

FIGURE 555. Leydigia leydigi, female:

L — Ladka River, 14 August 1962; HS — after Frey, 1962a.

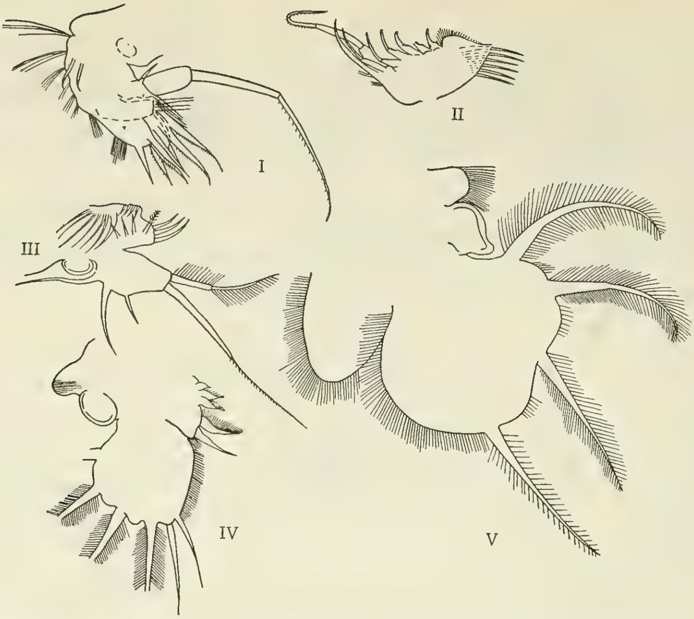

FIGURE 556. Legs of female of Leydigia leydigi (Ladka River, 14 July 1962):

I — right leg, inner side; II, IV — right legs, outer side; III, V — left leg, outer side.

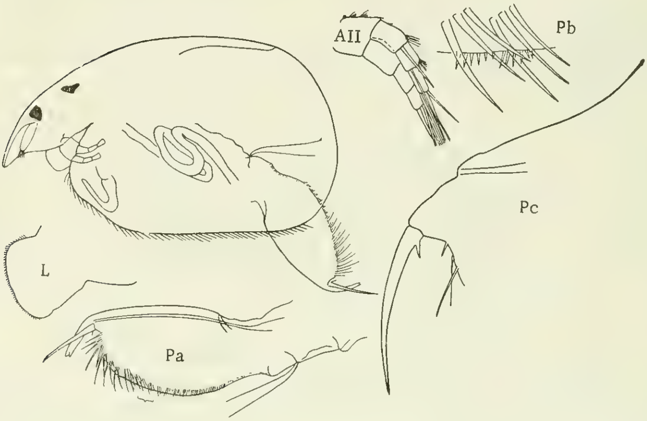

FIGURE 557. Leydigia leydigi, male, length 0.58 mm (Ladka River, 14 August 1961, preparation 435):

Pa, Pb — postabdomen and group of lateral setae (if the lateral setae of both sexes are drawn to scale it appears that those of the male are relatively much smaller); Pc — juvenile male, length 0.44 mm, distal part of postabdomen (Ladka River, 14 August 1962, preparation 444).

(453)

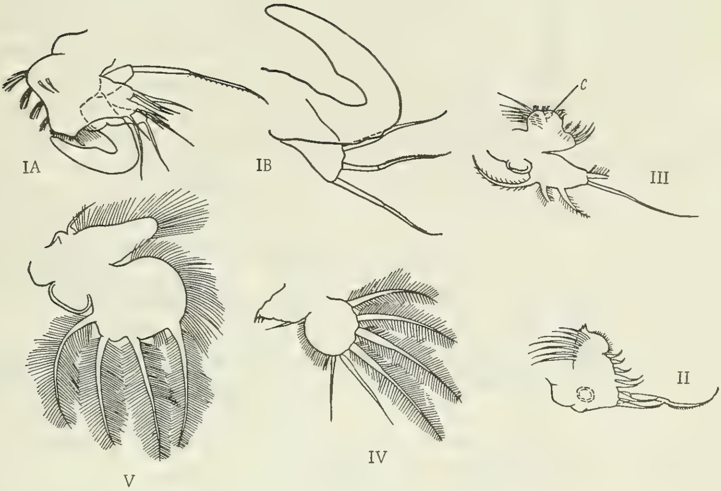

FIGURE 558. Legs of male of Leydigia leydigi (Ladka River, 14 August 1962):

IA, II, IV – right legs, inner side; IB – outer branch of endite, outer side; III, V – right legs, outer side.

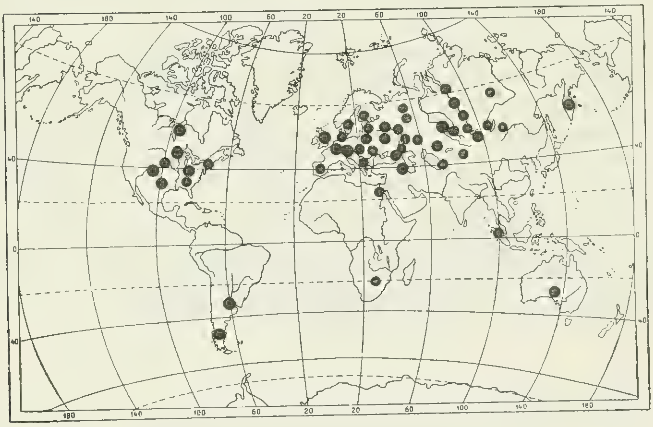

FIGURE 559. Distribution of Leydigia leydigi

Head shield with 3 connected main pores (Frey, 1959). Lateral pores situated near middle pore; reticulation or lines absent. Distance from main pores to posterior margin of head shield slightly longer than distance between main pores. Ventral margin of head S-shaped. Dorsal keel on head or valves absent. Antennules not reaching apex of rostrum. Antennules with a sensory seta on the anterior margin distal to the middle. Setae on antennae: 0–0–3/1–1–3, spines 1–0–1/3–3–1. Segments of endopodite with basal groups of setae. Basis with groups of setae at the margin. Plate of labrum with setae on the anterior margin, of varying form. Maxillules with 3 pubescent setae, the middle seta longer.

451 Outer branch of endite of leg I with 3 setae, 2 of them long, brushlike, the third hook-shaped, about one third as long (Figure 119). Exopodite of leg I with a long seta about twice as long as the longest seta on outer branch of endite. Exopodite and outer branch of endite cylindrical, elongate. Exopodite of leg III with an elongate plate with 5 setae. Exopodite of leg IV rounded. Leg V very large, with a deep incision between the exopodite and the lobe of the endopodite. Exopodite widened, with 4 setae.

Postabdomen with ventral incisions. Anal margin slightly concave, with setae. Dorsal distal margin of postabdomen with a row of small denticles on each side, with groups of setae laterally which decrease in size proximally. Distal seta the largest in each group. Last group small, situated near the claws. Claw with one basal spine.

According to Frey (1960) concave margin of claw with a row of setae which decrease in size proximally, basal spine not longer than basal width of claw. Ocellus larger than eye, situated slightly nearer to eye than to apex of rostrum. Length to 1 mm.

Male. Posterodorsal corner of valves at level of highest point of body. Posteroventral corner rounded, without denticles.

Antennules not reaching apex of rostrum. Setae on antennae: 0–0–3/1–1–3. Plate of labrum rounded, with setae on the anterior margin.

454 Postabdomen widest in the middle. Anal margin slightly concave, with groups of small setae. Anal denticles very small, forming groups. Groups of lateral setae well developed. Vas deferens opening on apex of penislike process. Endite of leg I anteriorly with a brush of setae opposite the hook, in addition to the usual rows of setae. Outer branch of endite of leg I with setae of slightly different length. Ocellus slightly larger than eye. Length to 0.7 mm. In the juvenile male, the vas deferens opens ventrally some distance from the base of the claw and the penislike process is absent. Length to 0.44 mm.

Distribution. Holarctic and Neotropical regions, South Africa, Sumatra, Australia. European USSR: to 80°E in the east.

Biology. Lives in silt. Monocyclic if the water freezes; dicyclic if an ice sheet does not develop (Vereshchagin, 1912b).

2. Leydigia macrodonta Sars, 1916

Female. Posterodorsal corner distinct at level of maximum height. Antennules almost reaching apex of rostrum. Labrum with distinct angular apex. Postabdomen with about 8 groups of lateral setae. Claw slightly curved, with a small basal spinule. Groups of postabdominal spinules with 1 long and 2–3 short spinules. Ocellus larger than eye.

Male. Unknown.

Key to Subspecies of L. macrodonta

1 (2). Groups of lateral spinules with 1 long spinule . . . . 2a. L. macrodonta macrodonta Sars, 1916.
2 (1). Groups of lateral spinules with 2 long spinules . . . . 2b. L. macrodonta louisi Jenkin, 1934.

2a. Leydigia macrodonta macrodonta Sars, 1916

Sars, 1916:328–329, Plate XXXVII, Figures 2, 2a, 2b (macrodonta).

Female. Antennule almost reaching apex of rostrum. Groups of lateral setae with 1 long seta. Intestine with a short caecum.

Distribution. South Africa.

2b. Leydigia macrodonta louisi Jenkin, 1934 (Figure 561)

Jenkin, 1934:283–285, Figure 14 (var. louisi).

Material. British Museum 71. 1939. 4. 25. 16.

Female. Posterior margin of valve more vertical than in the type form. Valves granulate, sometimes reticulate posteriorly. Plate of labrum with rounded apex and pubescent anterior margin. Groups of postabdominal spinules consisting of 2 long and 1–2 short spinules. Two groups of short spinules at base of claws. Claw with setae on the whole concave margin, middle seta longer than the others. Ocellus triangular.

Distribution. Kenya, East China (Huang-Ho River).

3. Leydigia ciliata Gauthier, 1939 (Figures 562–566)

Gauthier, 1939 (January):169–173, Figures 9a–g (propinqua var. ciliata); Birabén, 1939 (May):661–663, Figures 14–16 (striata); Harding, 1955:242–243, Figures 50–60; Shen, Sung and Chen, 1964, Figures 28–34.

Material. Numerous females from Lake Karmak-Kul' in the Aktyubinsk Region and New South Wales, Australia. One female from Atkinson's Lagoon (Queensland, Australia); one male from Lake Karmak-Kul', one male from New South Wales. Preparations: MGU – female 2041, male 1977. ZIN – female 2039. Ph – female 2043.

Female. Valves with longitudinal rows of granules. Antennule not reaching apex of rostrum, with 2 groups of setae on the anterior side. Plate of labrum with undulate anterior margin, with hairs on the margin. Postabdomen with 28–31 lateral groups of setae. Distal groups with 4–5 short setae, groups 5–9 consisting of a longer distal seta and 2–3 shorter setae, groups 10–12 consisting of 2 setae, groups 13–20 with shorter setae,

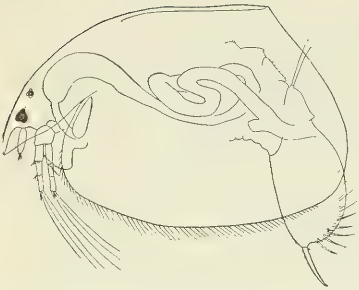

FIGURE 560. Leydigia macrodonta macrodonta, female (after Sars, 1916)

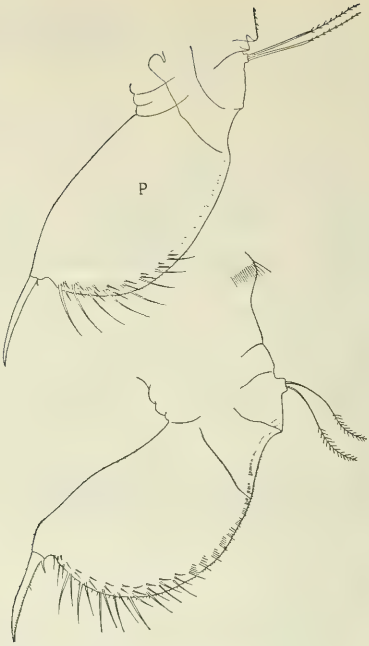

FIGURE 561. Postabdomen of Leydigia macrodonta louisi, female (after Jenkin, 1934)

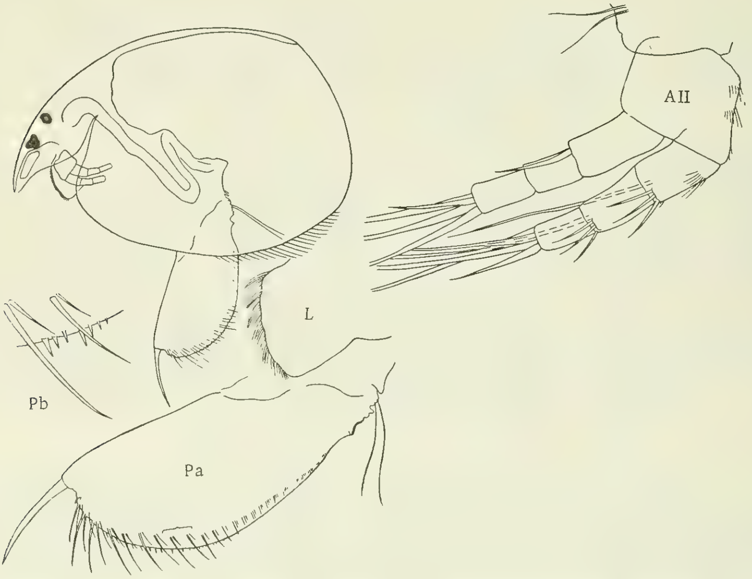

FIGURE 562. Leydigia ciliata, female, length 0.81 mm (Lake Karmak-Kul', Aktyubinsk Region, 15 August 1965, preparation 2041):

Pa, Pb — postabdomen and groups of lateral setae.

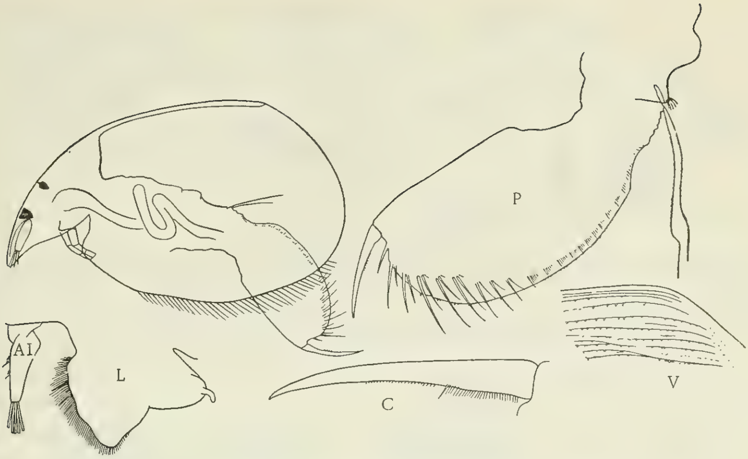

FIGURE 563. Leydigia ciliata, female, length 0.62 mm (Atkinson's Lagoon, Queensland, Australia, 12 February 1952, preparation 1769):

V, L, AI, C – after Gauthier, 1939.

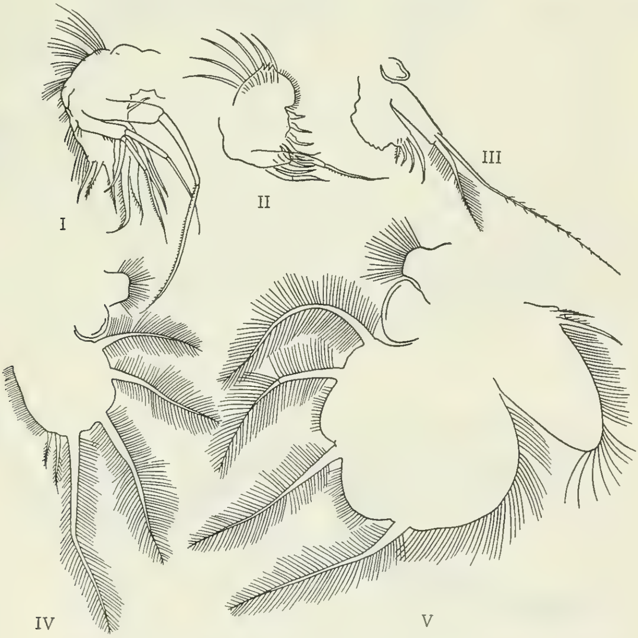

FIGURE 564. Legs of female of Leydigia ciliata (Lake Karmak-Kul', 15 August 1965):

I, II, III – left legs, outer side; IV – right leg, inner side; V – right leg, outer side.

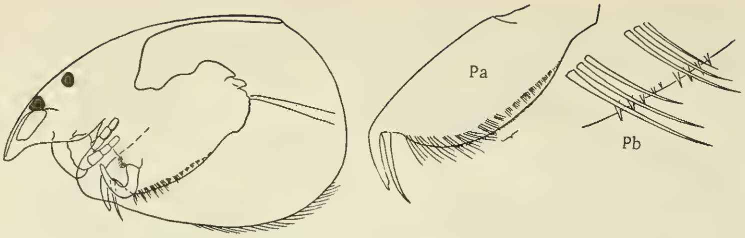

FIGURE 565. Leydigia ciliata, male, length 0.50 mm (Lake Karmak-Kul', 15 August 1965, preparation 1977):

Pa, Pb — postabdomen and groups of lateral setae.

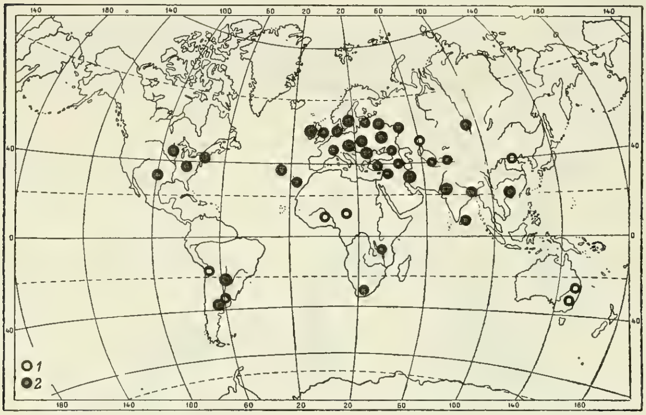

FIGURE 566. Distribution:

1 — Leydigia ciliata; 2 — L. acanthocercoides.

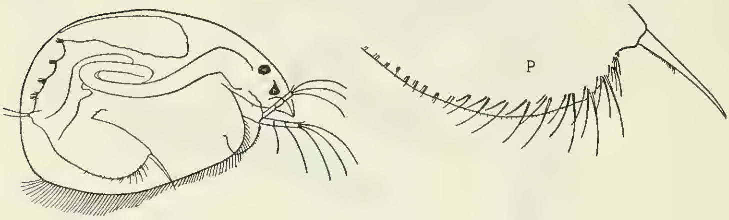

FIGURE 567. Leydigia laevis, female (after Gurney, 1927)

decreasing in size proximally, groups 21–31 barely reaching margin of postabdomen and consisting of about 4 setae. Anal denticles very small.

The females from Lake Karmak-Kul' have granulate valves; under high magnification the granules appear like irregular stars (formalin-fixed material). On the periphery of the valves the granules form concentric rows. Head shield and dorsal anterior part of the valve with fine, dense longitudinal lines which are hardly distinguishable in the posterior part of the valve. The number of setae in the lateral groups on the postabdomen (Figure 562) is not as given by Gauthier (1939).

458 Anal margin slightly convex, with setae. Claws without basal spine, sometimes with a small spine. Leg I with transverse rows of setules on anterior side of endite. Outer branch of endite of leg I with 3 setae, 2 of them long, thin, the third about half as long. Exopodite of leg I with a seta which is much longer than the setae on the outer branch of the endite. Leg III small. Leg IV with large rounded exopodite. Two short anterior setae on exopodite of leg IV. Leg V with very large exopodite with 4 equally spaced setae. Length to 0.97 mm.

Male. Posterodorsal corner of valve at level of maximum height. Antennules not reaching apex of rostrum. Plate of labrum with pubescent anterior margin. Ventral margin of postabdomen with incisions with setae. Claws without basal spine. Vas deferens opening on apex of penislike process. Ocellus larger than eye. Length to 0.7 mm.

Distribution. Ethiopian and Neotropical regions, Australia, East China. USSR: Kazakhstan.

4. Leydigia laevis Gurney, 1927 (Figures 567, 568)

Gurney, 1927:73–75, Figure 9.

Material. According to description.

Female. Valves without lines, punctate, sometimes with indistinct pattern of hexagons. Maximum height behind middle. Plate of labrum pubescent on anterior margin. Claw without basal spine, with setae on the concave margin. Intestine with a short caecum. Eye and ocellus equally large. Length 0.6 mm.

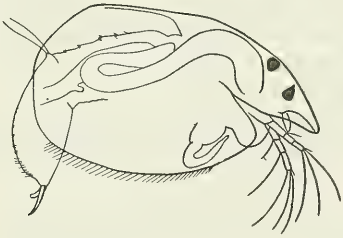

FIGURE 568. Leydigia laevis, male (after Gurney, 1927)

Male. Antennules not reaching apex of rostrum. Posterodorsal corner of valves indistinct, at level of maximum height. Posteroventral corner broadly rounded, without denticles. Claws without basal spine. Vas deferens opening on apex of penislike appendage. Intestine with a short caecum. Eye and ocellus almost equally large. Length 0.3 mm.

Distribution. Northeast Australia.

5. Leydigia acanthocercoides (Fischer, 1854)
(Figures 566, 569, 570)

Fischer, 1854:431–433, Plate III, Figures 21–23 (Lynceus); Schoedler, 1862:11 (Eurycercus); P. E. Müller, 1867:174, Plate IV, Figure 5 ((Alona); Kurz, 1875:59–60; Sars, 1895:18–22, Plate 4, Figures 1–4; Lilljeborg, 1900:499–502, Plate LXXI, Figures 4–8; Cosmovici, 1900:158–159, Figure 3 (Chydorus clavatus); 1901:305 (Ch. claratus); Ramult, 1930a:339–340, Plate 28, Figures 80, 81; Bening, 1941:290–292, Figure 120; Frey, 1959:37, Figures 19, 20; 1962a, Figures 19, 20; Šrámek-Hušek et al., 1962:356–358, Figure 133; Herbst, 1962:90; Negrea, 1966a:144.

Material. One female from the Samarkand Region near Nurata; two females from New South Wales, Australia.

Female. According to Fischer (1854) valves with longitudinal lines; the lines are curved and parallel to the anterior margin. Head shield and intervals between lines with fine striation. Posterior margin of valves without marginal row of spinules on the inner side. Rostrum blunt, short, directed anteriorly and slightly ventrally. Head shield with rounded posterior margin. Three connected main head pores (Frey, 1959). Lateral pores situated near median main pore. Distance from posterior main pore to posterior margin of head shield about 4 times longer than distance between marginal main pores. Plate of labrum with setae on the anterior margin. Postabdomen broadly rounded; anal margin concave. Lateral part of anus with several rows of setae. Fischer (1854) did not give a detailed description of the lateral groups of setae. According to Lilljeborg (1900), the lateral groups consist of 2 setae. Anal denticles very small. Two small
460 terminal groups near the claws. Claws without basal spine. According to Brehm (1933a), claw without setae. Ocellus larger than eye. Length to 1.15 mm.

Male. Valves with longitudinal lines. Antennules reaching to apex of rostrum. Plate of labrum with pubescent anterior margin. Anal margin with setae. Vas deferens opening on apex of penislike process. Ocellus larger than eye. Length to 1 mm.

Distribution. Holarctic, Ethiopian, Indo-Malayan and Neotropical regions. European USSR and to basin of Syrdar'ya and Enisei in the east.

6. Leydigia microps Sars, 1916 (Figures 571, 572)

Sars, 1916:330–331, Plate XXXVIII, Figures 2, 2a–d.

Material. According to description.

Female. Posterodorsal corner distinct. Valves with longitudinal lines. Antennules not reaching apex of rostrum. Plate of labrum with

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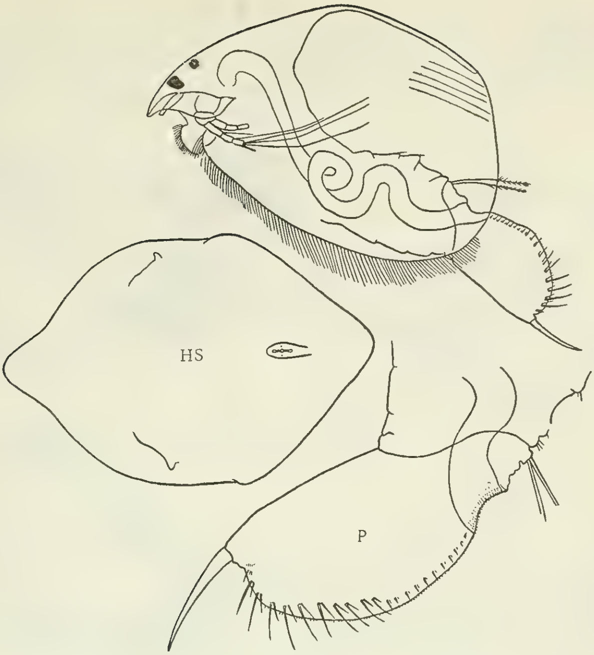

FIGURE 569. Leydigia acanthocercoides, female: P — after Lilljeborg, 1900; HS — after Frey, 1962a.

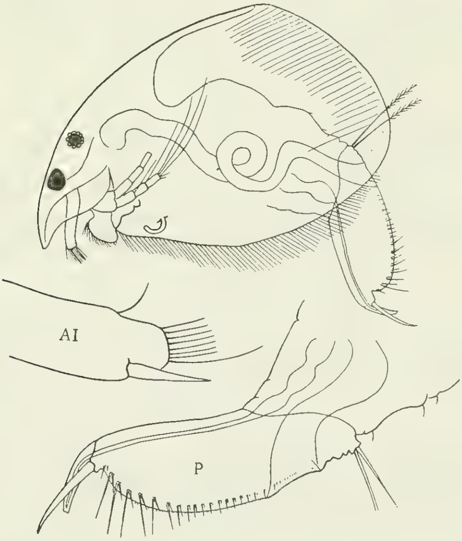

FIGURE 570. Leydigia acanthocercoides, male: P — after Lilljeborg, 1900; AI — after Sebestyén, 1965.

pubescent anterior margin. Postabdomen with very small anal denticles. Lateral spinules 12–14, decreasing in size proximally, each spine accompanied by a smaller spine. Claws without basal spine. Intestine forming loops, with a caecum. Ocellus larger than eye. Length to 0.86 mm.

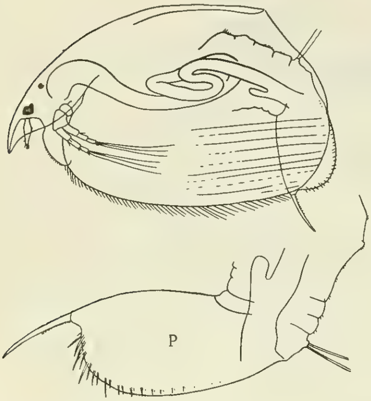

FIGURE 571. Leydigia microps, female (after Sars, 1916)

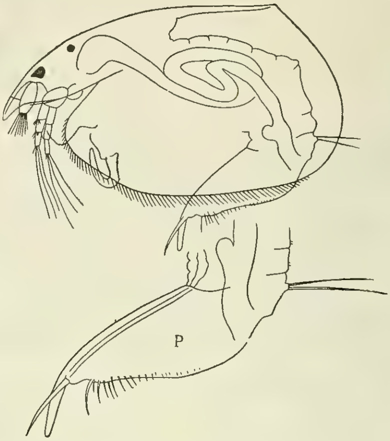

FIGURE 572. Leydigia microps, male (after Sars, 1916)

Male. Posterodorsal corner distinct. Antennules not reaching apex of rostrum.

Postabdomen narrowing distally. Vas deferens opening on apex of process ventral to the claws. Claws without basal spine. Intestine forming loops, with a caecum. Ocellus larger than eye.

Distribution. South Africa.

7. **Leydigia propinqua** Sars, 1903 (Figures 573, 574)

Sars, 1895:18, Plate IV, Figures 1–4 (acanthocercoides); Gurney, 1904a:300, Plate XVIII, Figures 5, 6 (africana); Sars, 1916:329–330, Plate XXXVIII, Figures 1, 1a; Brehm, 1937:509–510, Figure 5; 1951c:92.

Material. According to description.

Female. Antennules almost reaching apex of rostrum. According to Uéno (1938b) reticulation of valves in the form of lines. Plate of labrum with pubescent margin. Valves with 20 or more longitudinal lines (Brehm, 1938a) which are anastomosed, with longitudinal striation and dots between them; the dots are sometimes linear on the periphery of the valves (Brehm, 461 1937). Postabdomen with fewer spines than in L. schubarti. Claws with a very small basal spine. Only 7 distal spines accompanied by acessory spines. Ocellus almost as large as eye.

Male. Unknown.

Distribution. Africa, Sumatra, Java, China (eastern part and Taiwan), Brazil.

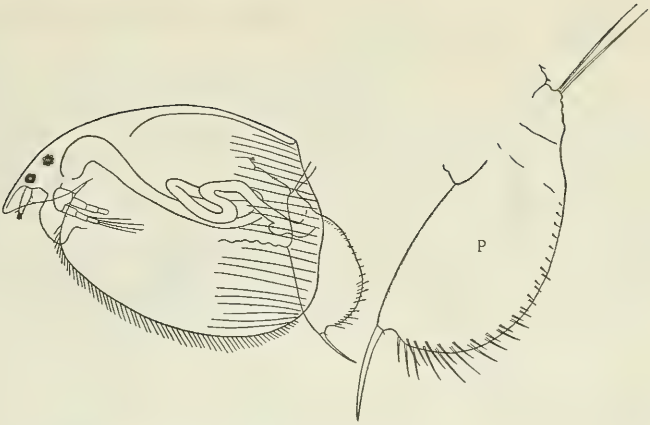

FIGURE 573. Leydigia propinqua, female: left side, after Sars, 1916; P — after Sars, 1903b.

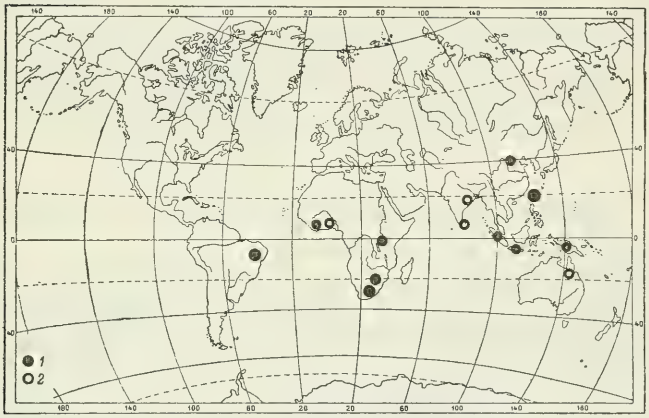

FIGURE 574. Distribution: 1 — Leydigia propinqua; 2 — L. australis australis.

8. **Leydigia** schubarti Brehm and Thomsen, 1936
(Figure 575)

Brehm and Thomsen, 1936:216–217, Plates 5, 6; Brehm, 1937:509–510 (Schubarti).

Material. According to description.

Female. Valves with concentric lines. Antennules almost reaching apex of rostrum. Postabdomen with 7 large setae distally, each accom- 462 panied by a smaller seta. These setae decrease in length proximally. Proximal to these groups is a row of 15 separate spines. Claws without basal spine.

Male. Unknown.

Distribution. Recife (Brazil).

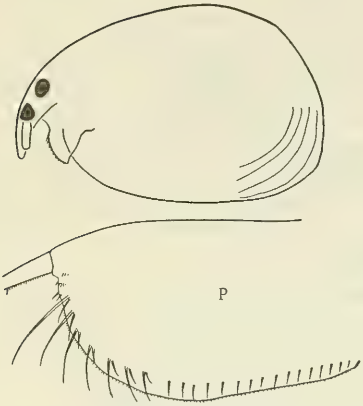

FIGURE 575. Leydigia schubarti, female (after Brehm and Thomsen, 1936)

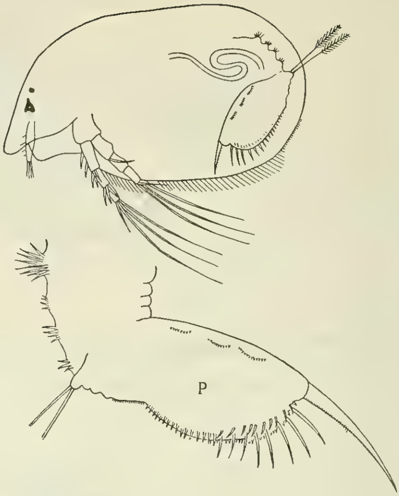

FIGURE 576. Leydigia trichura, female (after Fordyce, 1904)

9. **Leydigia trichura** Fordyce, 1904 (Figure 576)

Fordyce, 1904:49–51, Plate VI, Figures 2, 3.

Material. According to description.

Female. Outline of body elliptical, dorsal margin straight. Valve with indistinct longitudinal lines. Antennules projecting beyond apex of rostrum, with sensory setae on the anterior margin; distal end with esthetascs which are about half as long as the antennules. Rami of antennae of almost equal length, distal segments with three 2-segmented setae and a spine. First and second segments of exopodite with group of spines distally, first segment also with 2 spines on the outer margin. Endopodite with a spine on the basal segment. Postabdomen with convex dorsal and ventral side. Eight long denticles, followed by a row of 15–16 shorter denticles. The long denticles accompanied by 1–2 smaller denticles. Dorsal margin also with a row of short spinules, followed by a row of setae. Near the ventral margin are 3 curved groups of 7–10 spinules. Claws with setae on the concave margin, a larger seta in middle of row. Dorsal side of abdomen with 4 groups of spinules. Ocellus triangular, much larger than eye, situated nearer to eye than to apex of rostrum. Length to 0.8 mm.

Male. Unknown.

Distribution. Colorado (U.S.A.).

10. **Leydigia australis** Sars, 1885

Material. According to description.

Female. Posterodorsal corner blunt. Posteroventral corner rounded, without denticles. Antennules almost reaching apex of rostrum. Plate of labrum with pubescent anterior margin. Antennules with a sensory seta on the outer side in distal part. Setae on antennae: 0–0–3/1–1–3. Distal segments of antenna with one spine, one spine on proximal segment of endopodite; several spines on first and second segments of exopodite.
463 Dorsal side of body with 3 groups of setae distally. Postabdomen slightly narrowing distally, widest in the middle. Intestine with a double loop, without a caecum. Claws without basal spine. Ocellus much larger than eye.

Legs typical for the genus. Exopodite of leg I with a very long seta, feathered on one side. Outer branch of endite with 3 setae, one of them hook-shaped and about half as long as the others. Leg IV with a rounded exopodite. Leg V much larger than the other legs, with a very large oval exopodite. Length 0.84 mm.

Male. Antennules projecting beyond apex of rostrum. Postabdomen widest in the middle. Claw without basal spine. Ocellus larger than eye. Leg I with a hook and a brush of setae opposite the apex of the hook on anterior side of endite. Outer branch of endite of leg I with 3 setae of slightly different length. Length 0.46 mm.

Distribution. Africa, India, Ceylon, Australia.

Biology. Lives in loose bottom sediments (Sars, 1886:42).

Key to Subspecies of L. australis according to Females

1 (2). Valves without lines . . . . 10a. **L. australis australis** Sars, 1886.
2 (1). Valves with longitudinal lines . . . .
. . . . 10b. **L. australis ceylonica** Daday, 1898.

10a. **Leydigia australis australis** Sars, 1886 (Figures 574, 577, 578)

Sars, 1886:35–43, Plates 7, 8 (australis); Richard, 1892:14 (Alona).

Female. Valves without sculpture. Postabdomen with about 20 long lateral setae, each of them with 2–3 smaller setae near the base.

Distribution. Australia.

10b. **Leydigia australis ceylonica** Daday, 1898 (Figure 579)

Daday, 1898:41–43, Figure 19 (var. ceylonica).

Female. Valves with longitudinal lines and dots. Exopodite of antennae with 2 spine-shaped setae on the first and second segment, third segment with a spine-shaped seta and 3 normal setae. Plate of labrum with convex anterior margin with hairs and rounded apex. Postabdomen widest in the middle. Dorsal distal corner rounded. Claws with 2 rows of spinules

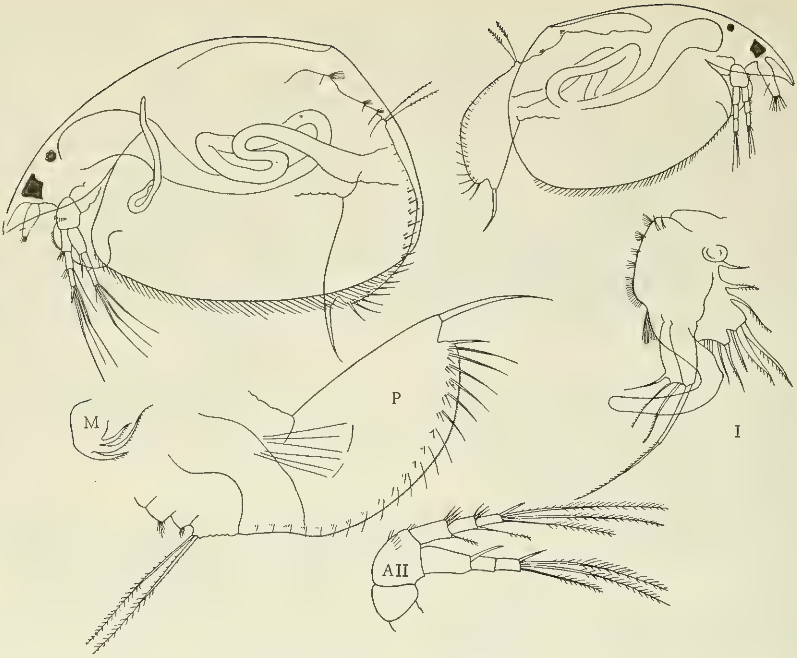

FIGURE 577. Leydigia australis, female (after Sars, 1886)

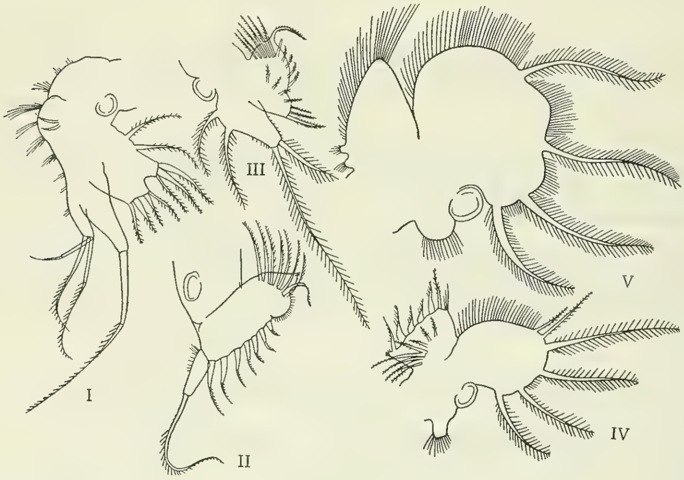

FIGURE 578. Legs of female of Leydigia australis (after Sars, 1886)

at the base. Postabdomen with 3 groups of 3 setae, the distal seta long in each group, the other setae becoming shorter proximally. In addition, 12–14 groups of spinules. Ocellus larger than eye, with crystalline lens, situated nearer to eye than to apex of rostrum. Length to 1 mm.

Distribution. Ceylon.

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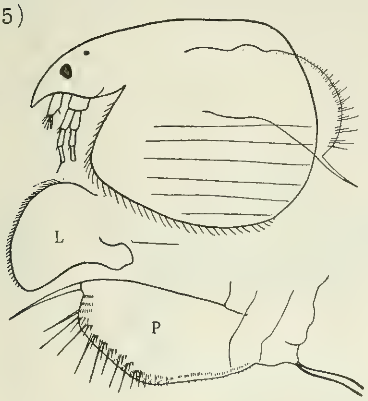

FIGURE 579. Leydigia australis ceylonica, female (after Sars, 1898)

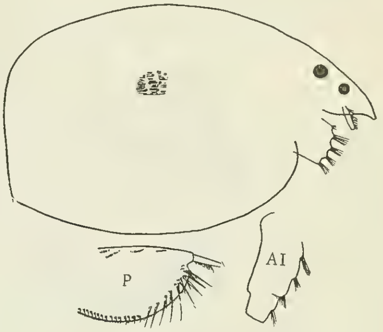

FIGURE 580. Leydigia ipojucae, female (after Brehm, 1938a)

11. **Leydigia ipojucae** Brehm, 1938 (Figure 580)

Brehm, 1938a:102–103, Plates 9, 10.

Material. According to description.

Female. Valves with lines and dots. Antennules with 4 incisions on the anterior margin, each incision with a group of setae. Plate of labrum with undulate anterior margin with 5 groups of setae on the processes.

Postabdomen with several rows of setae near the ventral side. Claw with very small basal spine and a row of setae which increase in length dorsally. Dorsal margin with 8–9 long spines accompanied by spines and groups of setae. Proximal to them are up to 20 groups of setae, the distal seta the longest in each group. Ocellus almost as large as eye.

Male. Unknown.

Distribution. East Brazil.

12. **Leydigia fimbriata** Fordyce, 1901 (Figure 581)

Fordyce, 1901:161–162, Plate XXIII, Figures 11–14.

Material. According to description.

Female. Valves with rounded posterodorsal and posteroventral corner. Valves with longitudinal rows of dots. Antennules almost reaching apex of rostrum. Dorsal apical corners of basal segment of antenna with 4 spines; 4 spines also on first and second segments of endopodite of

antenna. First segments of both rami also with a large spine. Setae on antennae: 0–0–3/0–1–3. Postabdomen with anal denticles in groups of 3–4, the proximal denticle smaller than the others in each group. A con-
465 tinuous row of long setae laterally. Dorsal surface of abdomen with hairs above the natatorial setae; a process with a spine between the hairs. Claws with setae in proximal part of the convex side and in proximal half of the concave side. One basal spine. Intestine forming loops, with a caecum. Length 0.55 mm.

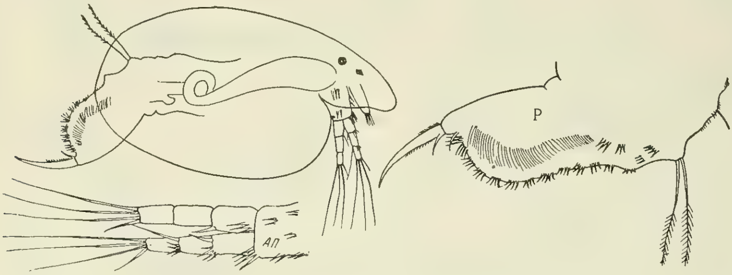

FIGURE 581. Leydigia fimbriata, female (after Fordyce, 1901)

Male. Postabdomen relatively narrow.
Distribution. Nebraska (U.S.A.).

Species incertae sedis

Leydigia balatonica Daday, 1888:95–96, Plate I, Figures 51, 52 (Alona); Sebestyén, 1965:203.

Sebestyén (1965:203) stated that this species (mentioned by Daday as Alona acanthocercoides Fischer) and Alona balatonica n. sp. (female 750–850μ) were found near the shore at Siofok (on the east shore of Lake Balaton). The morphology of this form (structure of valves, antennules, form and armature of labrum, setae of claw of postabdomen) suggest that it is intermediate between Alona acanthocercoides Fischer and Leydigia leydigi.

Leydigia leydigi var. leopolitana Dybowski and Grochowski, 1895:150 (L. quadrangularis var. Leopolitana). Nomen nudum.

Leydigia leydigi var. wojnowiensis Dybowski and Grochowski, 1895:150 (L. quadrangularis var. Wojnowiensis). Nomen nudum.

Leydigia hardingi Nayar, 1971, Hydrobiologia, 37:516, Figures 49–51.

466 19. Genus Biapertura N. N. Smirnov gen. n.

Type species: Biapertura affinis (Leydig, 1860). (B. karua (King, 1853) has not been sufficiently described and illustrated so that it cannot be used as the type species of the genus).

Female with oval body. Posterior margin of valve slightly shorter than maximum height. Head convex dorsally, without keel. Setae on antennae: 0–0–3/1–1–3 or 0–0–3/0–1–3; spines: 1–0–1/0–0–1. Main head pores situated in median line of head shield, one small pore on each side. Two main head pores with a narrow connection between them.

Posteroventral corner of valves sometimes with small denticles. Head shield with rounded anterior margin, rostrum therefore blunt in lateral view. Plate of labrum large.

Postabdomen more or less wide laterally, anus situated near its base, dorsal margin with anal denticles, lateral surface with groups of fine spinules.

Abdominal part not long, without dorsal processes.

The genus is so named because it has two main head pores.

Five pairs of legs. Leg I with transverse rows of setules on anterior side of endite. Outer branch of endite with 3 setae. Endite of leg II with 8 hard setae, without soft setae. Exopodite small, with one seta. Leg III with endopodite and exopodite of about equal size. Exopodite with 7 setae; seta 6 the largest (very long). Endite bifid, with a row of hard setae and a row of soft setae. Head setae of endite in 2 groups. A group of short hard setae on the side of the gnathobase around the sensilla; group of hard setae on the exopodite side consisting of 3 setae, 2 of them strongly chitinized, the other feathered. Leg IV with rounded exopodite with setae which differ little in length; 2 anterior setae not feathered, in contrast to the others. Leg V with large exopodite which is only slightly bifid in B. affinis and B. kendallensis. Endite and preepipodite lobe-shaped. Epipodites with or without short processes. Length to 1 mm.

The male has no anal denticles on the postabdomen. Vas deferens opening at base of claws, ventral to them. Leg I of male of B. affinis with a hook and a brush of setae on the endite opposite the hook. Outer branch of endite of leg I with 3 setae which differ only slightly in length. Exopodite of leg I with a seta which extends to the end of the setae of the outer branch of the endite.

This genus is characterized by 2 main head pores with a narrow connection between them. Endite of leg III bifid, exopodite of leg IV with 6 setae.

Key to Species of the Genus Biapertura according to Females

1 (12). Plate of labrum without denticle.
2 (11). Posteroventral corner of valve without denticles.
3 (10). Preanal margin short.
4 (9). Postabdomen not widening distally.
5 (8). Anal denticles large.
6 (7). Anal denticles without setae on the posterior margin (some denticles may have little developed setae). Distal setae of antennae with a spine at the articulation between first and second segment . . . . 1. **B.** affinis (Leydig, 1860) comb. n.
7 (6). Anal denticles with setae on the posterior margin. Distal setae of antennae without a spine at the articulation between first and second segment . . . . 2. B. kendallensis (Henry, 1919) comb. n.

8 (5). Anal denticles small. Dorsal and ventral margin of postabdomen usually parallel . . . . 3. **B. longinqua** N. N. Smirnov, sp. n.
9 (4). Postabdomen widening distally. Lateral setae projecting beyond margin of postabdomen . . . . 4. **B. intermedia** (Sars, 1862) comb. n.
10 (3). Preanal margin as long as distance from preanal corner to base of claws . . . . 5. **B. rigidicaudis** N. N. Smirnov, sp. n.
11 (2). Posteroventral corner of valves with denticles . . . . 6. **B. karua** (King, 1853) comb. n.
12 (1). Plate of labrum with denticle . . . . 7. **B. pseudoverrucosa** N. N. Smirnov, sp. n.

Key to Known Males of the Genus Biapertura

1 (4). Postabdomen not strongly tapering distally.
2 (3). Posteroventral corner of valves without denticles . . . . 1. **B. affinis**.
3 (2). Posteroventral corner of valve with denticles . . . . 6. **B. karua**.
4 (1). Postabdomen strongly tapering distally . . . . 4. **B. intermedia**.

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1. **Biapertura affinis** (Leydig, 1860) comb. n.

The subspecies are not distinguished in the following publications: Leydig, 1860:223, Plate IX, Figures 68, 69 (Lynceus); Hartwig, 1897c:177 (Alona quadrangularis affinis); Bening, 1941:312–315, Figure 129 (Alona); Frey, 1958:249–252, Plate 38, Figures 49–56 (Alona); 1959:35–36, Figures 36, 37; 1962a, Figures 36, 37 (Alona); Herbst, 1962:89, Figure 69 (Alona); Manuilova, 1964:246–247, Figure 130 (Alona); Negrea, 1966a:143 (Alona).

Female. Maximum height in the middle of body. Posteroventral corner of valves with a row of groups of setae continuing in a row of spinules on the inner side of the posterior margin. Valves with longitudinal lines; transverse lines may be also present, forming a network. Two main head pores, with a narrow connection between them. Lateral pores at level of anterior main pore. Head shield with pointed posterior margin. Antennules not reaching apex of rostrum. Setae on antennae: 0–0–3/1–1–3. Antennae with spines on proximal segment of exopodite and on both distal segments. Seta of proximal segment of exopodite not reaching apex of exopodite. A spinule at the articulation between the segments of the distal setae. Plate of labrum of varying form, with convex anterior margin. Postabdomen usually uniformly widening. Dorsal distal margin rounded, anal denticles 14–16. Most anal denticles with pubescent proximal side. Postabdomen with lateral groups of setae. Claws and its basal spine with setae on the concave margins. Ocellus smaller than eye, situated nearer to eye than to apex of rostrum.

Legs typical for the genus. Leg I with transverse rows of setae on the anterior surface. Outer branch of endite with 3 setae; the hook-shaped seta large, only slightly shorter than the other setae. Outer branch of endite with groups of spinules on the inner surface.

Exopodite of leg V slightly bifid, its anterior seta directed anteriorly (not ventrally). Endite in form of a broad lobe, with 2 large setae. Gnathobase of leg V with 3 setae. Length, according to material from the Rybinsk Reservoir, 0.46 (1st stage) to 1.05 mm, minimum length of gravid females 0.71 mm (3rd stage).

Male. Body twice as long as high. Valves with rounded posteroventral and posterodorsal corner. Antennules not reaching apex of rostrum. Setae on antennae: 0–0–3/1–1–3. Plate of labrum with rounded anterior margin and blunt apex. Postabdomen narrowing distally, without anal denticles, with lateral groups of setae. Preanal corner not projecting. Claws with a basal spine. Concave margin of basal spine with 4–6 setae. Vas deferens opening ventrally at base of claws. Leg I with a hook and a brush of setae on the endite opposite the hook. Outer branch of endite of leg I with 3 setae of slightly different length. Exopodite of leg I with a seta which reaches to the end of the setae on the outer branch of the endite. Length to 0.72 mm.

Juvenile male. Vas deferens opening ventrally some distance from base of claws. Length 0.65 mm.

Biology. Monocyclic at vegetation periods lasting to 3.5 months, dicyclic at longer vegetation periods (Vereshchagin, 1912b).

Key to Subspecies of B. affinis according to Females

1 (8). Posteroventral corner of valves without large spine-shaped setae.
2 (7). Antennules without a group of hairs.
3 (4). Longitudinal striation between the longitudinal lines on valves or in polygons absent . . . . 1a. **B. affinis affinis** (Leydig, 1860).
4 (3). Fine striation between longitudinal lines on valves.
5 (6). Valve with pattern of polygons . . . . 1b. **B. affinis ornata** (Stingelin, 1895).
6 (5). Valve with longitudinal lines without connecting transverse lines . . . . 1c. **B. affinis elegantula** (Brehm, 1933).
7 (2). Antennules with a group of hairs . . . . 1d. **B. affinis barbata** (Brehm, 1935).
8 (1). Posteroventral corner of valve with 2 large spiniform setae . . . . 1e. **B. affinis dentata** (Werestschagin, 1911).

1a. **Biapertura affinis affinis** (Leydig, 1860) comb.n.

(Figures 582–587)

Baird, 1843:92–93, Plate III, Figures 9–11 (Alona quadrangularis); Liévin, 1848:40, Plate X, Figures 6, 7 (Lynceus quadrangularis); Fischer, 1851:189–190, Plate IX, Figures 3–6 (Lynceus quadrangularis, placed in this species because the articulation of the setae bear spines); Schoedler, 1858:28 (Alona spinifera); 1862:18–19, Plate I, Figures 17–22 (A. spinifera); 1863:18–19, Plate I, Figures 17–22 (A. spinifera); P. E. Müller, 1867:175–176, Plate III, Figures 22–23, Plate IV, 1, 2 (A. oblonga; the illustration of the head pores of A. oblonga and the other figures of P. E. Müller prove the synonymy);

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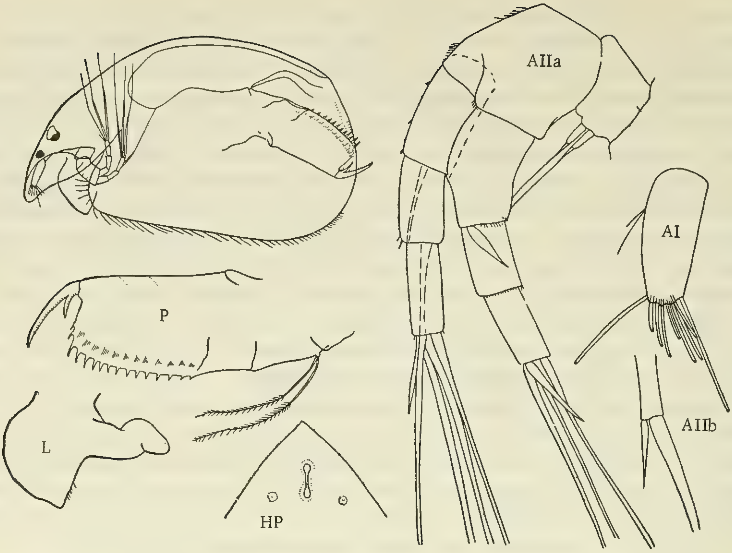

FIGURE 582. Biapertura affinis affinis, female, length 0.84 mm:

P — Rybinsk Reservoir, 15 August 1962); L — Shumorovka River, 2 August 1962; HP — after Frey, 1962a; AIIa — left antenna, outer side (Shumorovka River, 2 August 1962); AI — left antennule, dorsal (Shumorovka River, 2 August 1962); AIIb — articulation of seta on distal segment of exopodite of antenna (Rybinsk Reservoir, Bor Timonino, 13 June 1961).

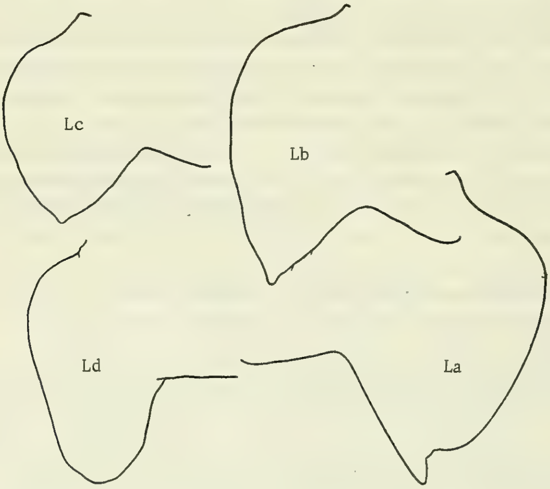

FIGURE 583. Labrum of Biapertura affinis affinis, female, Rybinsk Reservoir:

La — length 1.06 mm, Bor Timonino, preparation 38; Lb — length 0.94 mm, Borok, preparation 1119; Lc — length 0.68 mm, Borok, preparation 1173; Ld — length 0.8 mm, Borok, preparation 1102.

469)

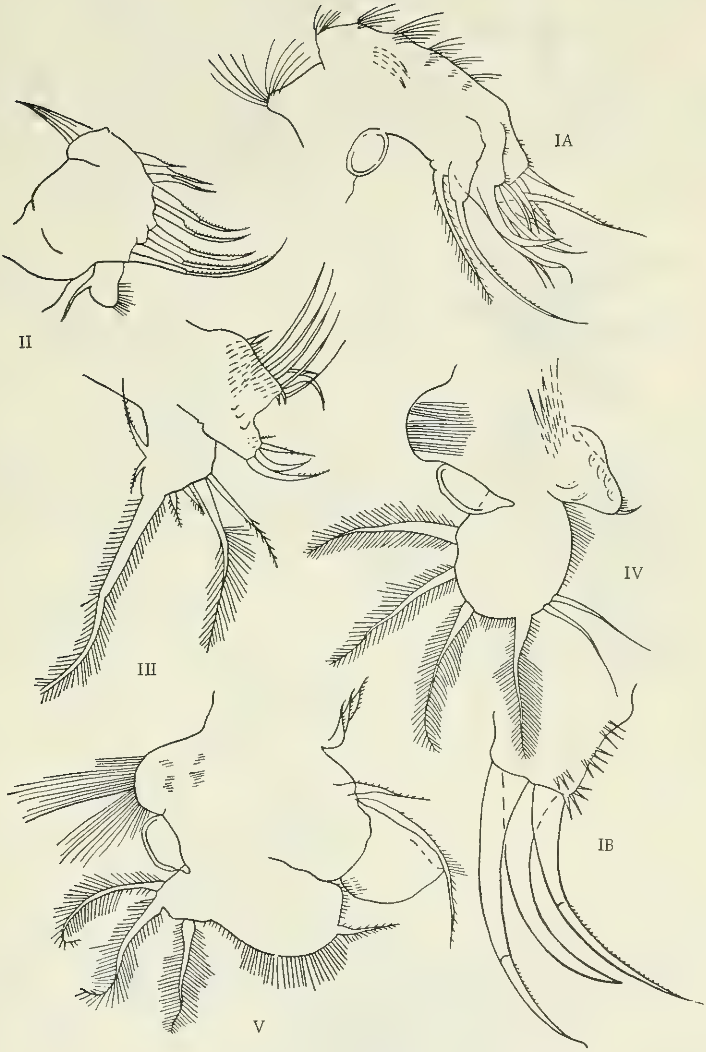

FIGURE 584. Legs of female of Biapertura affinis affinis, right side (Shumorovka River, 2 August 1962):

IA, IV, V — outer side; IB — outer branch of endite of leg I, outer side; II, III — inner side.

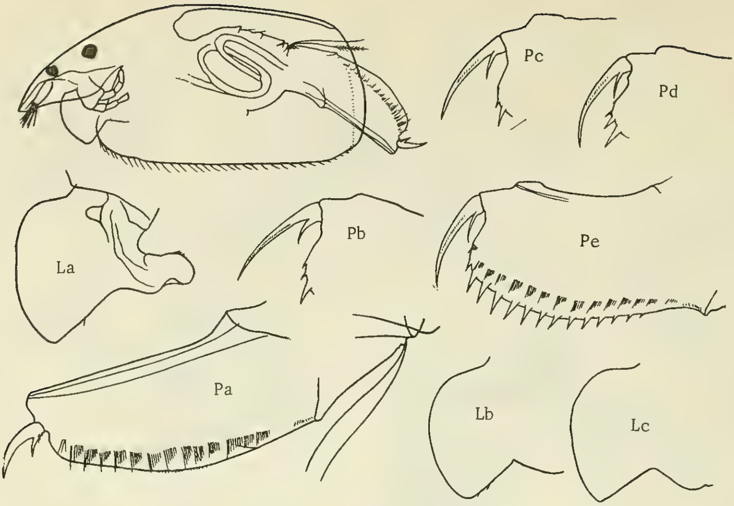

FIGURE 585. Biapertura affinis affinis, male, length 0.68 mm:

Pa — postabdomen (Rybinsk Reservoir, Borok, 18 September 1962); Pb, Pe — postabdomens of juvenile males, specimens with the following length from top to bottom: 0.65, 0.65, 0.61, 0.64 (Rybinsk Reservoir, Borok, 2 October 1962, preparations 1101, 1105, 1106, 1103); La — Cherepovets Reservoir, 18 October 1963; Lb — juvenile male (Rybinsk Reservoir, Borok, preparation 1105); Lc — same, preparation 1101.

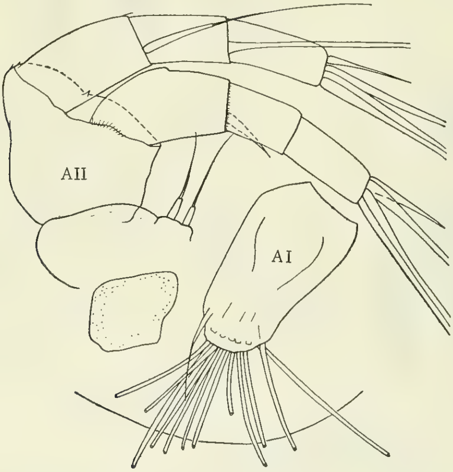

FIGURE 586. Biapertura affinis affinis, male (Cherepovets Reservoir, 21 October 1963):

AII — left antenna, ventral; AI — right antennule, ventral.

Stingelin, 1895:244–245, Plate VII, Figure 33 (A. affinis); Sars, 1896b: 35–37, Plate 6, Figures 1, 2 (A. whiteleggii); Lilljeborg, 1900:454–461, Plate LXVI, Figures 18–21, Plate LXVII, Figures 1–17, Plate LXVIII, Figure 1 (Lynceus affinis); Sars, 1901:48–49, Plate IX, Figures 1,
471 1a–d (Alona affinis); Stingelin, 1906:324–325, Plate 13, Figures 1, (A. affinis); Levander, 1915:25 (A. quadrangularis var. affinis); Sars, 1916:331–332, Plate XXXIX, Figures 1, 1a (A. affinis); Henry, 1919:475–476, Plate XLI, Figures 11, 12 (A. longirostris); Birabén, 1939:656–658, Figures 7, 8 (A. affinis); Baldi, 1941:234–246, Plate XXVIII (A. affinis f. tovelana); Šrámek-Hušek et al., 1962:342 (A. affinis var. affinis); Sebestyén, 1965:197–201, Plates 1, 2 (A. affinis).

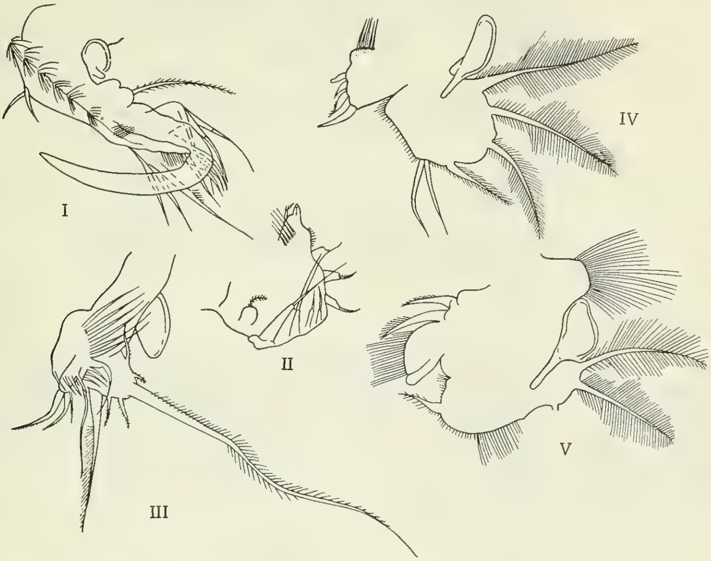

FIGURE 587. Legs of male of Biapertura affinis affinis, left side (Cherepovets Reservoir, 21 October 1963):

1 – anterolateral; II–V – outer side.

Material. Numerous females from the Rybinsk Reservoir, the Komi ASSR, water bodies in Pamir, Lake Issyk-Kul', Lake Sonkul', New South Wales (Australia); several females from Lake Kyla-Kol' (southern Kirghizia). Numerous males from the Rybinsk and Cherepovets reservoirs,
472 from a small lake on the north shore of Lake Issyk-Kul'. Preparations: MGU – female 41, ephippial female 1119, ephippium 1166, male 1094, juvenile male 1102. ZIN – female 53888 (40), ephippial female 53889 (1175), ephippium 53890 (1167), male 53891 (1172), juvenile male 53892 (1104).

Female. Polygons on valves without striation; posteroventral corner without long setae.

Distribution. Cosmopolitan.

1b. Biapertura affinis ornata (Stingelin, 1895) comb.n.
(Figures 384, 588)

Stingelin, 1895:245–246, Plate VII, Figure 32 (Alona affinis var. ornata); Lilljeborg, 1900:456 (A. affinis var. ornata); Parenzan, 1932:153–154, Plate II.4 (A. ornata); Šrámek-Hušek et al., 1962:342 (A. affinis var. ornata).

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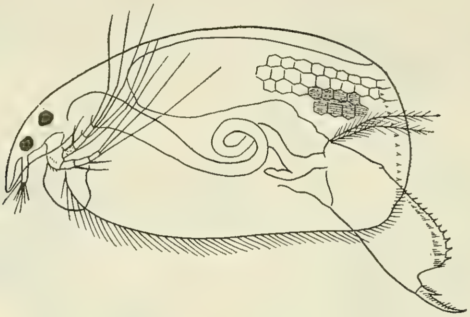

FIGURE 588. Biapertura affinis ornata, female (after Stingelin, 1895)

Female. Valves with longitudinal lines connected by numerous anastomoses, forming distinct hexagons with longitudinal striation and dots in them. Two esthetascs longer than the others. Esthetascs projecting beyond apex of rostrum. Lateral seta situated near distal end of antennule (not in the middle). Anal spinules 15. Length 0.77 mm.

Distribution. Switzerland, Peru.

1c. Biapertura affinis elegantula (Brehm, 1933) comb.n.
(Figure 589)

Brehm, 1933b:130–132, Figures 1, 2 (Alona affinis var. elegantula).

Female. Valve with indistinct longitudinal lines without transverse connecting lines. Fine striation between lines on valves. Distal lateral groups on postabdomen ending in a spine, and setae proximal to them. Antennules with 7 short and 2 long esthetascs. Lateral seta situated proximal to the middle. Antennules with a row of setae in the middle and near the end.

Distribution. Indonesia.

1d. Biapertura affinis barbata (Brehm, 1935) comb.n.

Brehm, 1935a:153–154, Figure 8 (Alona affinis var. barbata); 1956:227 (A. affinis var. barbata).

Female. Antennules with a group of long setae in the basal third. Groups of short setae also present.

Distribution. Kenya, Venezuela.

1e. **Biapertura affinis dentata** (Werestschagin, 1911) comb.n. (Figure 590)

Werestschagin, 1911b:555 (*Alona affinis* var. *dentata*); 1912b:131–133, Figures 55, 66 (A–*affinis* var. *dentata*); Bening 1941:315 (A. *affinis* var. *dentata*); Šrámek-Hušek et al., 1962:342 (A. *affinis* var. *dentata*); Roen, 1968:154–158, Figure (A. *affinis dentata* subsp.n.).

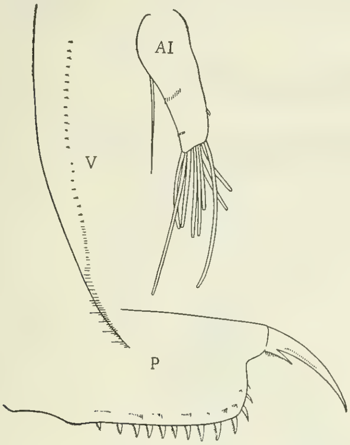

FIGURE 589. *Biapertura affinis elegantula*, female (after Brehm, 1933a)

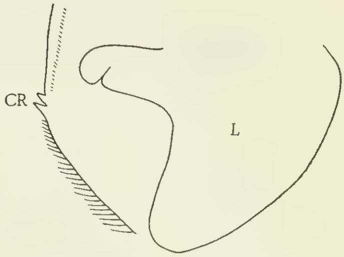

FIGURE 590. *Biapertura affinis dentata*, female (after Vereshchagin, 1912a)

Female. Described by Lilljeborg (1900:459, Plate XVII, Figure 12) but not established as a separate taxon. Ventral corner of valves with 2
474 relatively large setae. Labrum with rounded apex.

Distribution. Sweden. European USSR (Novgorod Region and Caucasus).

2. **Biapertura kendallensis** (Henry, 1919) comb.n. (Figures 591, 592)

Henry, 1919:474–475, Plate XLI, Figures 9, 10 (*Alona*).

Material. Numerous females from New South Wales; several females from Queensland, Australia. Preparations: MGU – female 1770.

Female. Valves with rounded posteroventral and posterodorsal margin. Valves with longitudinal lines. Antennules $^2/_3$ of length of rostrum. Spinule on articulation of distal setae of antenna absent.

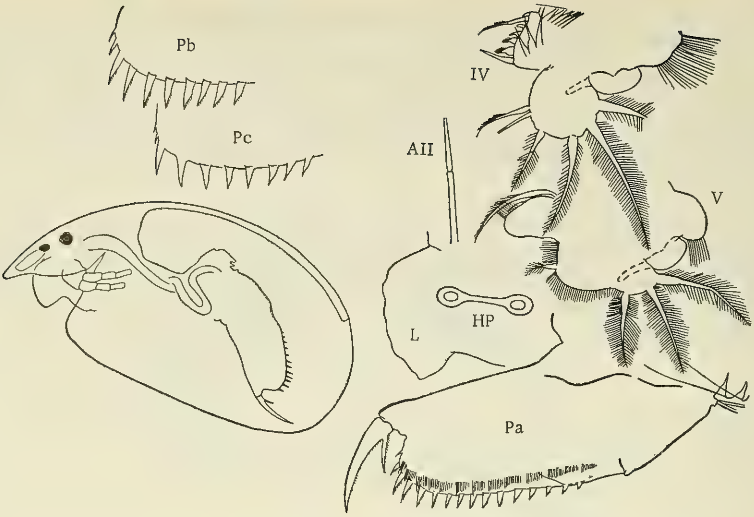

FIGURE 591. Biapertura kendallensis, female, length 1.06 mm (Llangothlin Lagoon, New South Wales, Australia, 17 August 1967, preparation 1770):

Pa, Pb — postabdomen and anal denticles; Pc — denticles of postabdomen of B. affinis (Rybinsk Reservoir, Bor Timonino, 13 June 1961, preparation 43); IV, V — right legs, inner side.

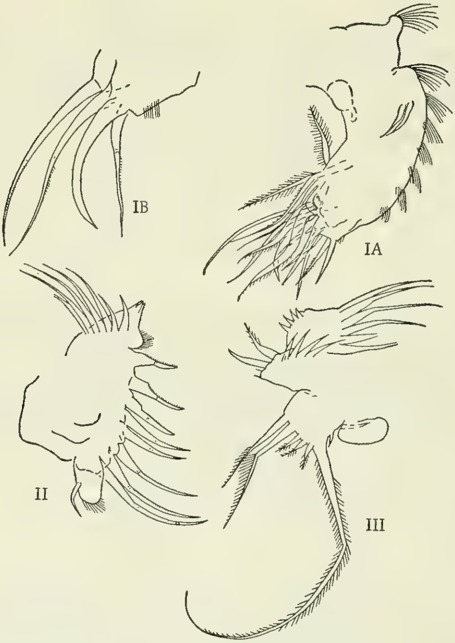

FIGURE 592. Legs I, II, III of female of Biapertura kendallensis:

IA, IB, II — right legs, inner side; III — left leg, outer side. The exopodite of leg III bears 3 short middle setae instead of the usual 2.

Postabdomen wide, with parallel margins. Postanal margin twice as long as preanal margin. Anal denticles and lateral setae present, denticles with spinules on the proximal side. Lateral setae in 12–13 groups.

Outer branch of endite of leg I with 3 setae, inner seta in form of a large hook. Outer branch of endite with a group of setae (not spines). Epipodite of legs IV and V with processes which are almost as long as the epipodite but not reaching the opposite margin of the exopodite.

Ocellus slightly smaller than eye, situated nearer to eye than to apex of rostrum.

Closely resembling B. affinis; it differs from it in the presence of setae on proximal side of anal denticles, the absence of a spinule on articulation of distal setae of antenna, and the long processes on the epipodites of legs IV and V. Length to 1 mm.

Male. Unknown.

Distribution. Queensland, New South Wales (Australia).

3. Biapertura longinqua N. N. Smirnov sp. n. (Figure 593)

Material. Three females from Moriset Hospital Dam, New South Wales, Australia; several females from Queensland.

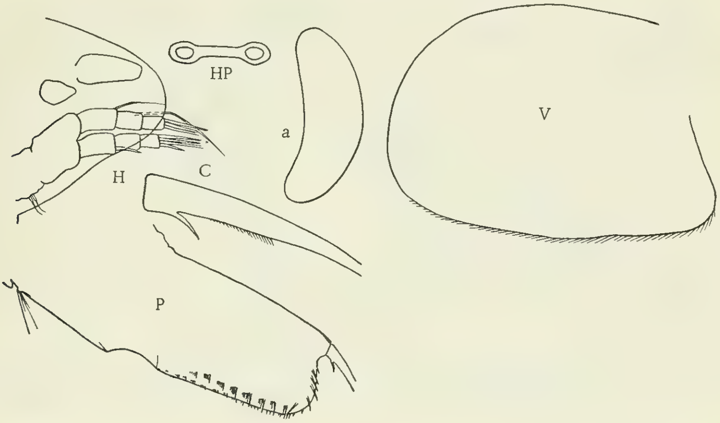

FIGURE 593. Biapertura longinqua, female, length to 0.4 mm (Moriset Hospital Dam, New South Wales, Australia, 15 August 1967):

P — preparation 676; a — parasitic protozoon from the body of one specimen.

Holotype. MGU – female 676. Paratype. ZIN – female (postabdomen) 54155 (953).

Female. Maximum height in the middle of body. Posterodorsal and posteroventral corner of valves rounded. Head pores typical for the genus. Rostrum blunt. Antennules almost reaching apex of rostrum. Setae on antennae: 0–0–3/1–1–3. Plate of labrum rounded.

Postabdomen with parallel dorsal and ventral margin. Preanal margin much shorter than postanal margin. Distal margin convex. Anal denticles small but distinct. Lateral setae large, distal setae projecting beyond margin of postabdomen. Distal margin of postabdomen with about 4 such setae. Dorsal margin with setae in groups, distal seta larger, proximal setae shorter and thinner. Setae of proximal groups not projecting beyond margin of postabdomen.

475 Claw with a basal spine and with setae on the concave margin which increase slightly in length from the basal spine to the middle of the concave margin.

Only 2 setae were found on the outer branch of the endite of leg I. Length to 0.4 mm.

This species differs from related species in the form of the postabdomen and the structure of the lateral setae and anal spines.

Male. Unknown.

Distribution. Queensland, New South Wales (Australia).

Biology. Parasites were found in the body cavity of one female (Figure 593).

4. Biapertura intermedia (Sars, 1862) comb. n.

Female. Posterodorsal and posteroventral corner of valves rounded. Valves with longitudinal lines. Head shield with rounded posterior margin. Two connected main pores. Antennules almost reaching apex of rostrum. Posterior margin of antennules with a sensory seta distal to the middle. Antennae with a spine on proximal segment of exopodite and on both distal segments. Postabdomen with strongly widened distal end. Preanal corner distinct. Anal denticles 8–9. Eight–nine groups of setae laterally (13 groups according to Delachaux, 1919). Distal seta larger than the others in each group. Setae of distal groups projecting beyond margin of postabdomen. Claw with a basal spine. Ocellus slightly larger than eye, situated halfway between eye and apex of rostrum. Length to 0.45 mm.

Male. Valves with rounded posterodorsal and posteroventral corner. Antennules reaching to apex of rostrum. Postabdomen narrowing distally. Preanal corner not projecting. Claw without basal spine. Ocellus smaller than eye, situated halfway between eye and apex of rostrum. Length 0.25 mm.

Key to Subspecies of B. intermedia according to Females

1 (2). Postabdomen strongly widening distally .... 4a. B. intermedia intermedia (Sars, 1862).

2 (1). Postabdomen not strongly widening distally .... 4b. B. intermedia minor (Stingelin, 1905).

4a. Biapertura intermedia intermedia (Sars, 1862)

(Figures 594–596)

Sars, 1862b:286–287 (Alona intermedia); Scott, 1895:189, Plate V, Figures 4, 18 (A. neglecta); Stenroos, 1898:195, Plate III, Figures 15–18

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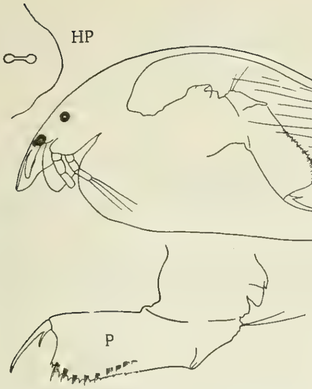

FIGURE 594. Biapertura intermedia intermedia, female, length 0.44 mm:

P — Vel'yu River, Pechora Basin, 2 August 1958, preparation 91; HP — after Frey, 1962a.

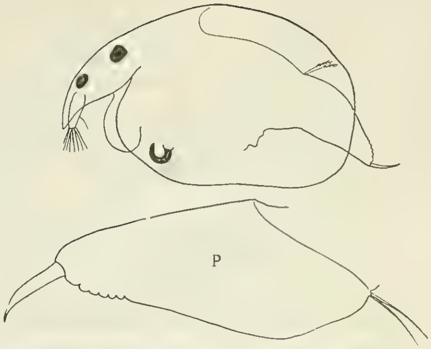

FIGURE 595. Biapertura intermedia intermedia, male (after Šrámek-Hušek et al., 1962)

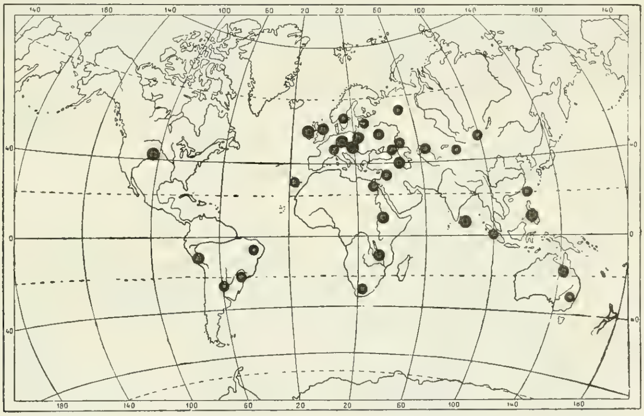

FIGURE 596. Distribution of Biapertura intermedia

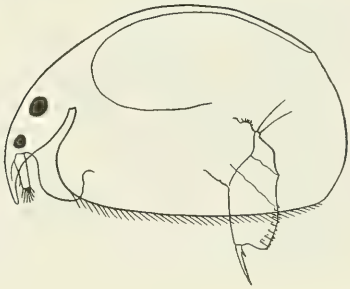

FIGURE 597. Biapertura intermedia minor, female (after Stingelin, 1905)

(A. rectangula); Lilljeborg, 1900:473–476, Plate LXVIII, Figures 27–29 (Lynceus intermedius); Sars, 1901:53–54, Plate IX, Figures 4, 4a (A. intermedia); Keilhack, 1911:472–473, Figures 12–14 (A. intermedia); Sars, 1916:334–335, Plate XXXIX, Figures 5, 5a (A. intermedia); Bening, 1941:315–316, Figure 130 (A. intermedia); Frey, 1959:35, Figures 32, 33; 1962a, Figures 32, 33 (A. intermedia); Šrámek-Hušek et al., 1962:339 (A. intermedia var. intermedia); Herbst, 1962:88, Figure 65 (A. intermedia); Chiang Sieh-chih, 1964:80–81, Figures 21–24.

Material. One female from the Vel'yu River (tributary of the Pechora) and from New South Wales (Australia). Preparation: MGU – female 91.

Female. Postabdomen strongly widening distally. Anal denticles isolated. Lateral setae in groups.

Distribution. Cosmopolitan. European USSR, mouth of the Syrdar'ya River. The record from northern Mongolia suggests that this species also may be present in the eastern USSR.

4b. Biapertura intermedia minor (Stingelin, 1905 (Figure 597)

Stingelin, 1905:351, Plate 12, Figure 22 (Alona intermedia minor).

Female. Postabdomen not strongly widening in distal part. Preanal corner distinct. Claws with a short basal denticle and with setae on the concave margin. Length 0.33 mm.

Distribution. Saigon.

5. Biapertura rigidicaudis N. N. Smirnov sp. n.
(Figures 598, 599)

Gurney, 1927:72, Figure 8E (Alona intermedia, structure of legs, head pores and posteroventral corner of valves not described).

Material. Numerous females from Doughboy Creek (Ebor, New South Wales, Australia).

Holotype. MGU – female 1288. Paratype. ZIN – female 53847 (1832).

Female. Maximum height in middle of body. Valves with rounded posterodorsal and posteroventral corner. Head pores typical for the genus. Antennules almost reaching apex of rostrum. Setae on antennae: 0–0–3/0–1–3; spines 1–0–1/0–0–1. Spine on basal segment of endopodite reaching
479 to middle of second segment. Spines of distal segments as long as the segments. Plate of labrum broadly rounded.

Postabdomen with long preanal margin, as long as the distance from the preanal corner to base of claws. Preanal corner not strongly projecting. Dorsal margin broadly rounded distally. Anal denticles small, about 7. Lateral setae in 9 groups, distal seta the longest in each group and projecting beyond margin of postabdomen in the 4 distal groups. Claws with a basal spine and with setae on the concave margin. Legs typical for the genus. Ocellus situated slightly nearer to eye than to apex of rostrum. Length 0.35 mm.

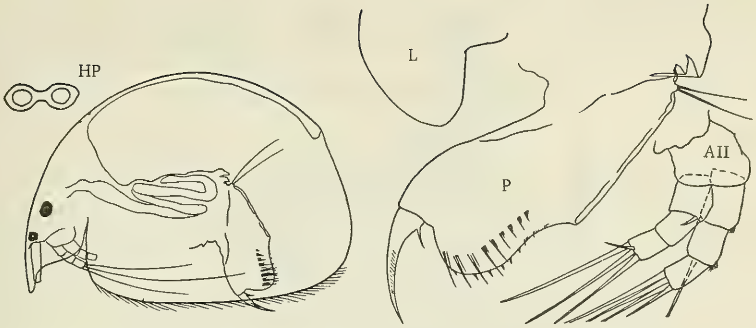

FIGURE 598. Biapertura rigidicaudis, female, length 0.35 mm:

AII — right antenna (Doughboy Creek, Ebor, New South Wales, Australia, 8 August 1965); HP — preparation 1288; L — preparation 1832.

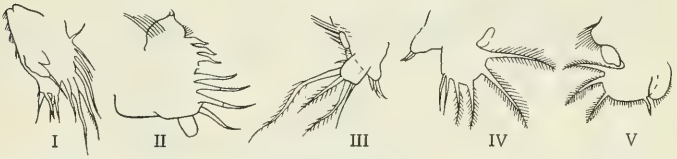

FIGURE 599. Legs of female of Biapertura rigidicaudis (Doughboy Creek, Ebor, Australia, 8 August 1965):

I, IV — left legs, outer side; II — right leg, inner side; III, V — right legs, outer side.

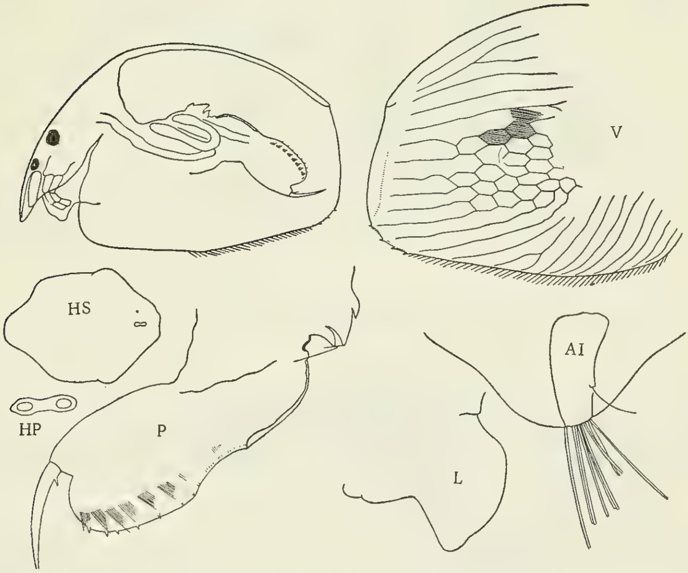

FIGURE 600. Biapertura karua, female, length 0.29 mm (University Pond, Brisbane, Queensland, Australia, 29 September 1964, preparation 1496):

HS — after Frey, 1962a; HP — University Pond, Brisbane, Australia, 29 September 1964; AI — right antennule, ventral.

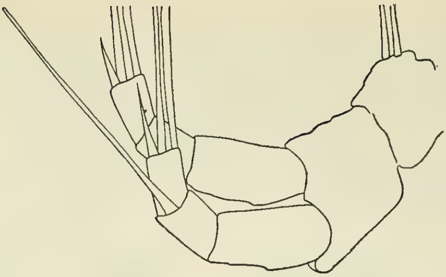

FIGURE 601. *Biapertura karua*, female, left antenna, ventral (University Pond, Brisbane, Australia, 29 September 1964)

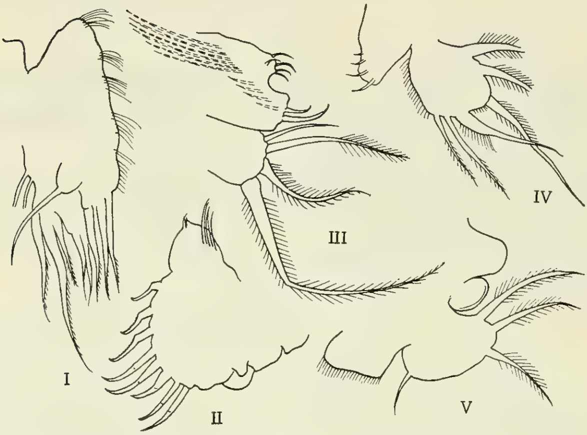

FIGURE 602. Legs of female of *Biapertura karua* (University Pond, Brisbane, Queensland, Australia):

I, III — right legs, outer side; II, IV — left legs, inner side; V — right leg, inner side.

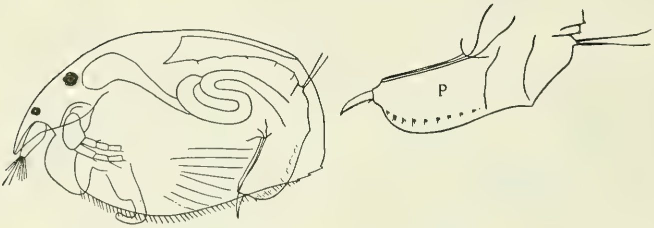

FIGURE 603. *Biapertura karua*, male (after Sars, 1901)

This species differs from related forms in the considerable length of the chitinized preanal margin of the postabdomen.

Male. Unknown.

Distribution. New South Wales (Australia).

6. Biapertura karua (King, 1853) comb.n. (Figures 600–604)

King, 1853:260, Plate VIII (Alona); Sars, 1888:50, Plate V, Figures 8, 9 (Alonella); Richard, 1897b:292, Figures 39–41 (Alona mülleri); Sars, 1901:59–60, Plate X, Figures 2, 2a–d (Alonella); Birge, 1910:1050 (Alonella karua); Daday, 1910b:122–123, Plate 6, Figures 9, 10 (Alonella); Brady, 1913:468, Plate XXXVI, Figure 10 (Leydigia quadridentata); Sars, 1916:337–338, Plate XL, Figures 4, 4a (Alona); Gauthier, 1929:152–153, Figure 6 (Alona); Bening, 1938:295, Figure 4 (Alonella); Bergamin, 1941:166 (Alonella); Ulomskii, 1959:53–54, Figure 13 (Alonella); Frey, 1959:35, Figures 30, 31; Mukhamediev, 1960a:68–69 (Alonella karua); Frey, 1962a, Figures 30, 31 (Alona); 1966 (Alonella karua var. dentifera Daday MS); Chiang Sieh-chih, 1963:258–259, 261–262, Figures 15–17 (Alona kwangsiensis); Goulden, 1966b:96 (Alona).

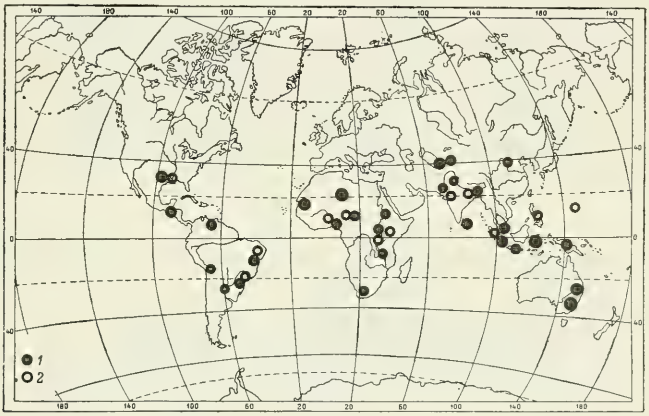

FIGURE 604. Distribution:

1 – Biapertura karua; 2 – B. pseudoverrucosa verrucosa.

Material. Numerous females from the White Nile; several tens of females from the Brisbane University Pond and from Gayndah, Queensland (Australia). Preparations: MGU – female 1496. ZIN – female 53893 (1424). Ph – female 1751.

Female. Maximum height before the middle. Posteroventral corner with 1–5 denticles. If several denticles are present, they are separated by the margin of the valve. Alona kwangsiensis Chiang Sieh-chih differs in the presence of 4–5 denticles on the posteroventral corner of the valves.

However, Stingelin (1905) described 3–4 denticles on the posteroventral corner of the valves of B. karua; A. M. Mukhamediev (1960a) also found 2–4 denticles. Valve with lines, a pattern of polygons and weak striation. Head shield with rounded anterior and posterior margin. Two connected main head pores. Antennules almost reaching apex of rostrum. Setae on antennae: 0–0–3/0–1–3. Postabdomen with broadly rounded dorsal distal margin. Preanal corner not projecting. Anal margin concave. About 8 small anal denticles. Lateral setae isolated or in groups (Ulomskii, 1959), projecting beyond margin of postabdomen, about 8 groups. Claw with a very small basal spine. Legs typical for the genus. Length to 0.49 mm (Mukhamediev, 1960a). The specimen of preparation 1496 is 0.29 mm long.

480 Male. Posteroventral corner of valve with denticles. Antennules reaching apex of rostrum. Plate of labrum rounded. Postabdomen with distinct preanal corner. Claws with a basal spine. Vas deferens opening ventrally near base of claws.

Distribution. Ubiquitous between 40° latitude N and S. USSR: Central Asia.

7. Biapertura pseudoverrucosa N. N. Smirnov, sp. n.

Material. According to description.

Female. Valves with rounded posterodorsal and posteroventral corner. Antennules reaching apex of rostrum. Plate of labrum sometimes with a denticle on the anterior margin. Postabdomen with 6–8 anal denticles. Lateral groups of setae present. Anal margin concave, with 8–10 groups of setae. Preanal corner projecting, blunt, with setae. Claws with setae and with a basal denticle. Ocellus situated nearer to eye than to apex of rostrum. Length to 0.35 mm.

Key to Subspecies of B. pseudoverrucosa

1 (2). Valve with lines, sometimes punctate, without tubercles . . . .
. . . . . 7a. B. pseudoverrucosa pseudoverrucosa N. N. Smirnov, ssp. n.
2 (1). Valve with tubercles, without lines . . . .
. . . . 7b. B. pseudoverrucosa verrucosa (Sars, 1901).

7a. Biapertura pseudoverrucosa pseudoverrucosa N. N. Smirnov, ssp. n. (Figure 605)

Daday, 1905:176–177, Plate XI, Figures 7, 8 (Alona rectangula).

Female. Valves with lines, sometimes finely punctate.

Distribution. Paraguay (reported only by Daday).

7b. Biapertura pseudoverrucosa verrucosa (Sars, 1901) (Figure 606)

Sars, 1901:56–57, Plate IX, Figures 7, 7a (Alona verrucosa); Brehm, 1933b:79, Figures 2, 3 (A. alonopsiformis); 1937:504–507

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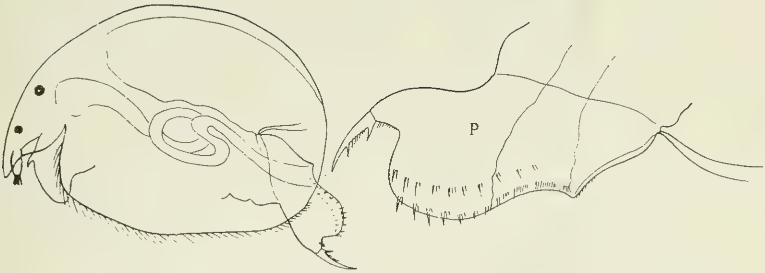

FIGURE 605. Biapertura pseudoverrucosa pseudoverrucosa (after Daday, 1605)

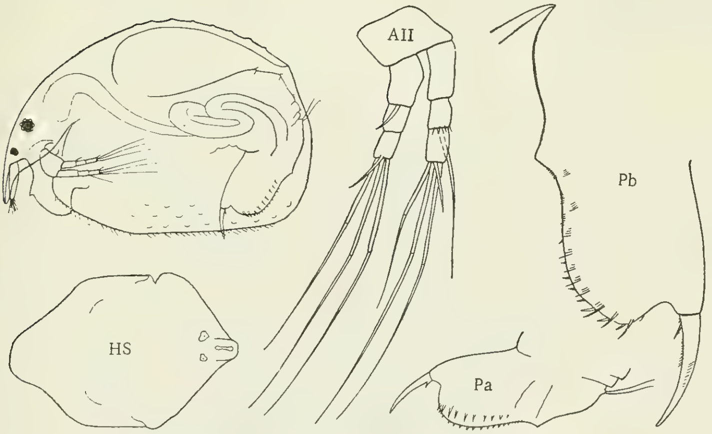

FIGURE 606. Biapertura pseudoverrucosa verrucosa, female:

Pa — postabdomen, after Sars, 1901; Pb, AII — antenna, outer side, after Green, 1952; HS — after De Costa, 1964.

(A. verrucosa); 1938a:100, Plates 6, 7 (A. verrucosa); Johnson, 1956a:200–204 (A. verrucosa); Harding, 1957b:77–78, Figures 20–28 (A. verrucosa); Goulden, 1966a:377 (A. verrucosa); 1966b:99, Plate 2, Figures 7, 8, 9 (A. verrucosa).

Female. Posteroventral corner of valve rounded, without denticles. Valves with large tubercles, without lines. Antennules almost reaching apex of rostrum. Setae on antennae: 0–0–3/0–1–3. Plate of labrum with a denticle or an incision in middle of anterior margin. Postabdomen short. Dorsal margin of postabdomen curved. Anal corner projecting, situated in about middle of dorsal margin of postabdomen. Distal margin rounded. Anal denticles small. Lateral setae larger, about 10 on each side. Claws with a small basal spine. According to Brehm (1938a) the specimens with a denticle on the anterior margin of the labrum have a relatively shorter postabdomen which widens more strongly distally and the anal denticles are much shorter than in specimens without a denticle. In specimens with a denticle on the anterior margin of the labrum, the postabdomen bears isolated lateral spines. If the anterior margin of the labrum is smooth, the anal denticles are relatively large and have setae on the posterior margin and the postabdomen bears lateral groups of setae. Ocellus smaller than eye, situated nearer to eye than to apex of rostrum.

Distribution. Indo-Malayan, Ethiopian, Neotropical regions.

20. Genus Tretocephala Frey, 1965

Frey, 1965a:153–154.

Type species. Tretocephala ambigua (Lilljeborg, 1900).

Body oval. Two broadly connected main head pores. Setae on antennae: 0–0–3/1–1–3; setae on basal and middle segments of endopodite of antennae well developed in the male and female. Antennules with a strongly projecting lateral tubercle with a sensory seta. Head shield wide, short. Lateral pores situated near the main pores. Labrum almost square.

Postabdomen elongate, with projecting distal corner. Anal groove short. Anal denticles in about 20 groups. Lateral setae also in about 20 groups, the distal seta longest in each group. Several groups of setae at the anal margin. Outer branch of endite of leg I of female with 3 setae, 2 of them long, the third about half as long. Vas deferens opening on ventral side of postabdomen on a process in the distal quarter. Claws with S-shaped
484 basal spine with setae on the concave margin, with a relatively large seta in the middle. Valves gaping ventrally before the middle. Valves with setae on the ventral margin, area of gape with shorter setae.

Key to Species of the Genus Tretocephala (Male and Female)

1 (2). Postabdomen with straight dorsal margin . . . . 1. T. ambigua (Lilljeborg, 1900).
2 (1). Postabdomen with concave dorsal margin . . . . 2. T. colletti (Sars, 1895).

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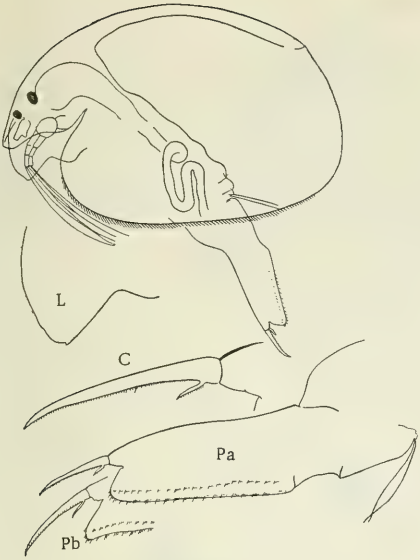

FIGURE 607. Tretocephala ambigua, female, length 0.9 mm (Lenkoran District, Mashikhanskii Istil', 25 May 1963):

Pa — postabdomen; Pb — end of postabdomen of ephippial female, length 0.94 mm, preparation 339.

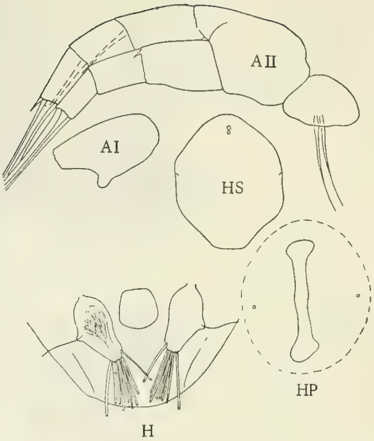

FIGURE 608. Tretocephala ambigua, female (Lenkoran District, 25 May 1963):

AII — left antenna, outer side; AI — left antennule, outer side; HS — preparation 1231; HP — head pores. The dotted line shows the porous field which is darker. Length of main pores 27 μ.

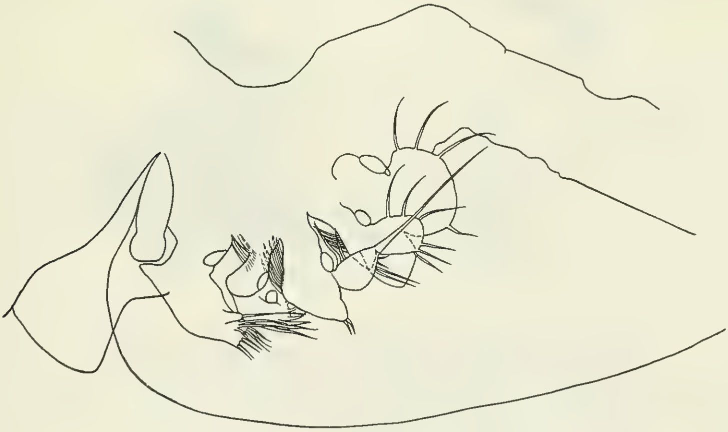

FIGURE 609. Arrangement of legs of female of Tretocephala ambigua (Lenkoran District, 25 May 1963, preparation 342)

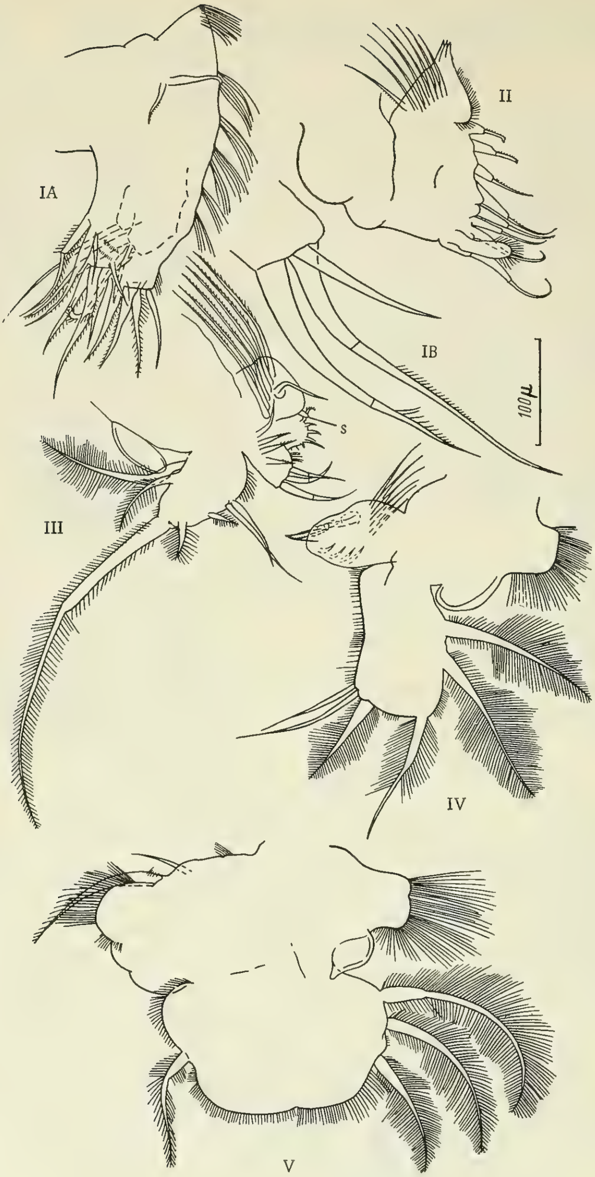

FIGURE 610. Tretocephala ambigua, female, left legs (Lenkoran District, 25 May 1963):

IA, II, IV, V — outer side; IB — outer branch of endite, inner side; III — inner side; s — sensilla.

1. Tretocephala ambigua (Lilljeborg, 1900 (Figures 607–614)

Daday, 1888:101, Plate 2, Figures 29, 31 (*Alonopsis elongata*); Lilljeborg, 1900:440–442, Plate LXV, Figures 21–24 (*Alonopsis*); Sars, 1903a:182, Plate VIII, Figures 2, 2a, 2b (*Alonopsis*); Gurney, 1905b:59–60, Figure 5 (*Alonopsis*); Bening, 1941:258–260, Figure 107 (*Alonopsis*); Šrámek-Hušek et al., 1962:326–328, Figure 120 (*Alonopsis*); Herbst, 1962:84, Figure 58 (*Alonopsis*); Frey, 1965a:154–162, Plate I, Figures 1–15 (*Tretocephala*); Smirnov, 1965a:121–134, Figures 11–16 (*Alona*).

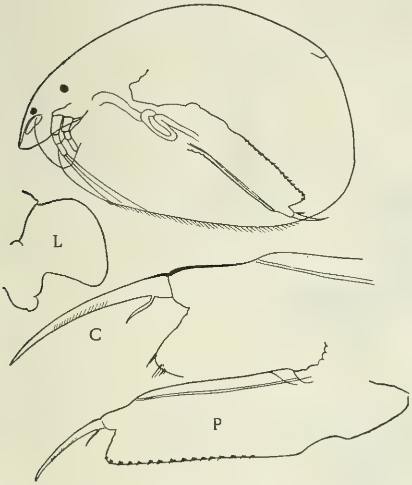

FIGURE 611. *Tretocephala ambigua*, male, length 0.65 mm (Lenkoran District, 25 May 1963, preparation 1233)

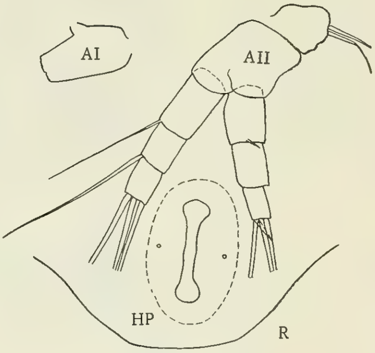

FIGURE 612. *Tretocephala ambigua*, male (Lenkoran District, 25 May 1963):

AI – left antennule, dorsal; AII – left antenna, dorsal; HP – length of main pores 24 μ.

Material. Numerous females from Lenkoran District (Mashikhanskii Istil') and Lake Kravtsevo (Stavropol' Territory). Several males from Lenkoran District. Preparations: MGU – females 332, 338, 342, 343, 344, 345, 347, 348, 349, 1235, exuviae of female 1232, ephippial female 339, ephippium 1226, males 340, 1233. ZIN – female 329, female exuviae 1230. Ph – female 333, 1231. Professor Frey's collection (State of Indiana University, Bloomington, U.S.A.) female, male, ephippium, female exuviae (1421.19–1421.22).

Female. Valve with rounded posterodorsal corner. Posteroventral corner rounded, without denticles. Ventral margin of valves with a row of setae passing posteriorly into a row of very short setae which continues on inner surface of posterior margin. Valves with irregular granules in concentric rows at the periphery. Head shield with rounded anterior and posterior margin. Two broadly connected main head pores, small pores situated laterally near the main pores. Head pores situated on an oval
486 porous field which is darker than the other part of the head shield.

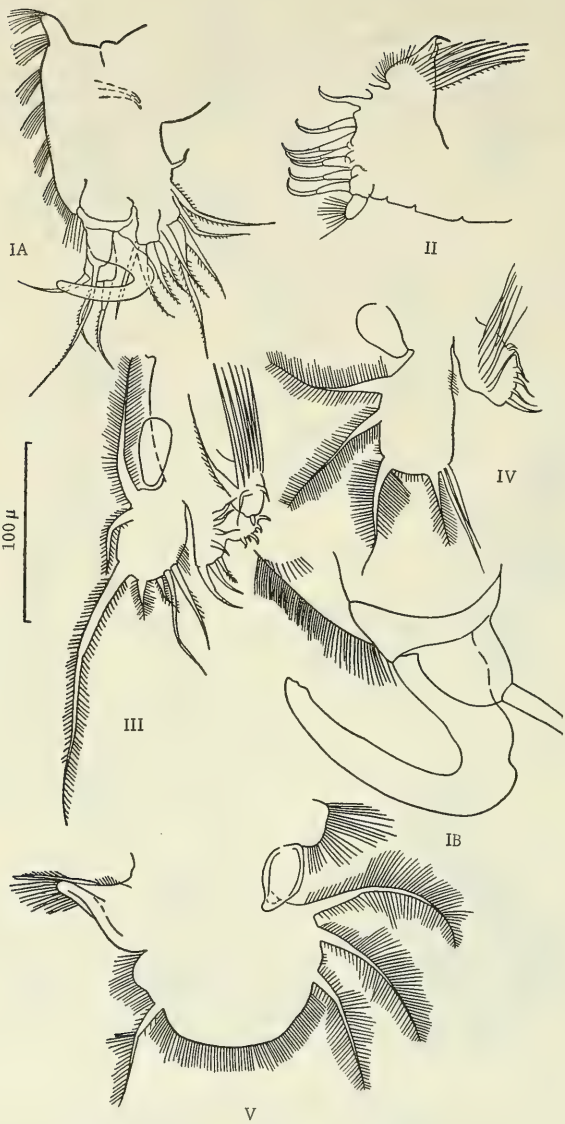

FIGURE 613. Tretocephala ambigua, male (Lenkoran District, 25 May 1963):

Legs of left side: IA, V — outer side; IB — hook, high magnification; II, III, IV — inner side.

Antennules not reaching apex of rostrum. One sensory papilla long, other sensory papillae shorter; sensory seta situated on a relatively large tubercle in middle of posterior margin. Maxillules with 3 pubescent setae, the middle seta larger (Lilljeborg, 1900). Setae on antennae: 0–0–3/1–1–3.
487 Labrum with rounded triangular process. Postabdomen almost uniformly wide. Dorsal distal end of postabdomen obliquely truncate. Dorsal distal corner rounded, slightly projecting in old females. Dorsal margin with 18–20 anal denticles which decrease in size proximally. Each denticle accompanied by setae. Groups of lateral setae present. Claws with setae on the concave margin and with pubescent basal spine. Concave margin with a row of small setae and one larger seta in the middle. Ocellus smaller than eye, situated about halfway between eye and apex of rostrum. Lilljeborg (1900) stated that the legs of Alonopsis ambigua resemble those of A. elongata and that A. ambigua is intermediate between the genera Acroperus and Lynceus (which is synonymous with Alona in Lilljeborg). However, Lilljeborg gave no description of the legs of Alonopsis ambigua. The authors illustrated the basal spine of the claw not S-shaped but straight in the female (Lilljeborg, 1900; Gauthier, 1928a) and in the male (Berg, 1929–1931). It is necessary to mention that the base of the claws of T. ambigua has no dorsal tubercle with setae, in contrast to Acroperus elongatus. Ocellus smaller than eye.

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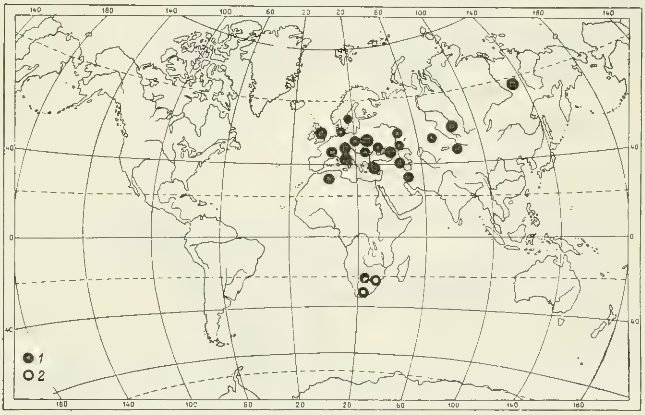

FIGURE 614. Distribution:

1 – Tretocephala ambigua; 2 – T. colletti.

Legs typical for the genus. Outer branch of endite of leg I with 3 setae, 2 of them long, the third hook-shaped and less than half as long. Exopodite of leg I with a seta which is longer than the longest seta on the outer branch of the endite. Exopodite of leg III with 7 setae, one of them 3 times as long as the longest of the other setae. The drawing shows a sensilla. Leg IV with setae of equal length. Leg V with a large lobe on the side opposite to the preepipodite. Epipodites with very short processes. Length to 0.94 mm.

Male. Posterodorsal and posteroventral corner of valves rounded. Rostrum blunt. Two broadly connected main head pores. Antennules not reaching apex of rostrum. Setae of antennae: 0–0–3/1–1–3. Plate of labrum rounded. Postabdomen with a row of groups of anal denticles but without lateral groups of setae. Basal spine S-shaped, small. Paris (1916) illustrated a straight basal spine. Head pores resembling those of the female. Leg I with a hook and with setae opposite the apex of the hook. Apex of hook blunt, slightly serrated on the concave side. Outer branch of endite of leg I with 3 setae of nearly equal length. Exopodite of leg I with a seta which is longer than the setae on the outer branch of the endite. Other legs as in the female. Vas deferens opening ventrally some distance from the base of claws. Ocellus smaller than eye, situated about halfway between eye and apex of rostrum. Anterior side of endite with a brush of setae opposite the hook. Length to 0.75 mm.

Distribution. Palearctic. Southern European USSR, to the Ob' in the east.

(486)

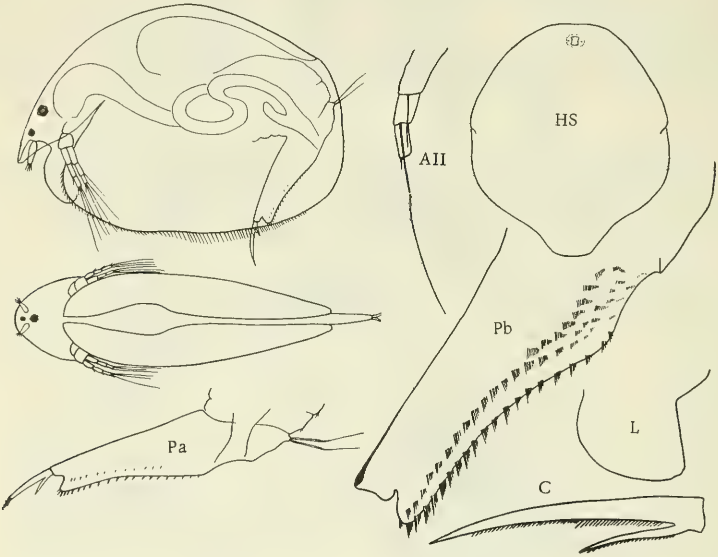

FIGURE 615. Tretocephala colletti, female:

Pa – after Sars, 1895; AII, HS, C, L, Pb – after Frey, 1965a.

2. Tretocephala colletti (Sars, 1895) (Figures 614–617)

Sars, 1895:22–25, Plate 4, Figures 5–8 (Alonopsis); 1916:341–342, Plate XLI, Figures 1, 1a, 1b (Euryalona); Brehm, 1958a:29, Figure 28 (Euryalona sp.nov.); Frey, 1965a:162–165, Plate II, Figures 17–31 (Tretocephala).

Material. According to description.

Female. Maximum height before middle of body. Posteroventral corner of valves rounded, without denticles. Ventral margin of valve with setae and with a concavity before the middle. Valves without sculpture. Head shield with rounded anterior and posterior margin. Two main head pores, with a broad connection between them. Antennules almost reaching apex of rostrum. Plate of labrum rounded. Postabdomen narrow, tapering distally. Claws with a basal denticle. Anal denticles about 22, more numerous distally. Preanal corner indistinct. Claws with basal denticle and with setae on the concave margin. Intestine forming loops, with a caecum. Ocellus smaller than eye, situated about halfway between eye and apex of rostrum. Length 1.17 mm.

Male. Posteroventral corner of valve rounded, without denticles. Antennules reaching apex of rostrum. Plate of labrum with rounded apex. Postabdomen with groups of lateral setae and with anal denticles in similar groups. Vas deferens opening ventrally some distance from base of claws. Claw with a basal spine. Intestine forming loops, with a caecum. Ocellus smaller than eye. Outer branch of endite of leg I with 2 long setae and a hook-shaped seta which is half as long; anterior side of endite of leg I with a brush of setae opposite the hook (Frey, 1965a). Length 0.8 mm.

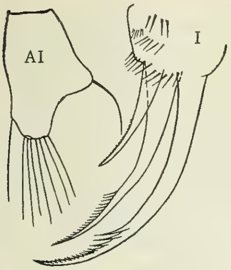

FIGURE 616. Tretocephala colletti, female (after Frey, 1965a):

I – outer branch of endite of leg I.

Distribution. South Africa.

489 21. Genus Rhynchotalona Norman, 1903

Sars, 1862b:289 (Alona, Harporhynchus); Herrick, 1884:114 (section Leptorhynchus); Norman, 1903; Bening, 1941:271 (Rhynchotalona, part); Herbst, 1962:89–90.

Type species: Rhynchotalona falcata (Sars, 1862).

Female with oval body. Posteroventral corner of valves rounded, with one or several denticles. Rostrum very long, directed posteroventrally. Two main head pores, with a broad connection between them. Antennules not reaching apex of rostrum. Setae on antennae: 0–0–3/0–1–3. Endopodite with swollen proximal segment. Postabdomen with anal denticles and lateral setae. Anal denticles not numerous, 2 distal denticles much larger than the others. Claw with a basal spine. Intestine forming loops, with a caecum. Eye about as large as ocellus. Vas deferens opening distally, ventral to base of claws.

Six pairs of legs. Leg I with rows of setae on anterior side of endite. Leg II with 8 hook-shaped setae; seta 6 most strongly chitinized and pectinate, with strongly developed tubercles on the concave margin. Gnathobase of leg II wide. Leg III with square exopodite with 5 setae posteriorly

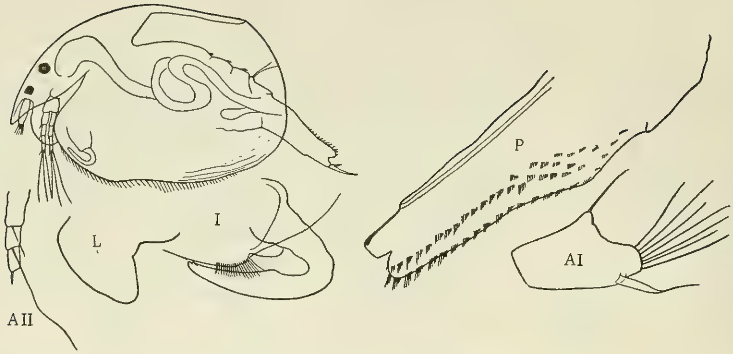

FIGURE 617. Tretocephala colletti, male, left side, after Sars, 1895:

AII – endopodite of antenna; L, P, I, AI – after Frey, 1965a.

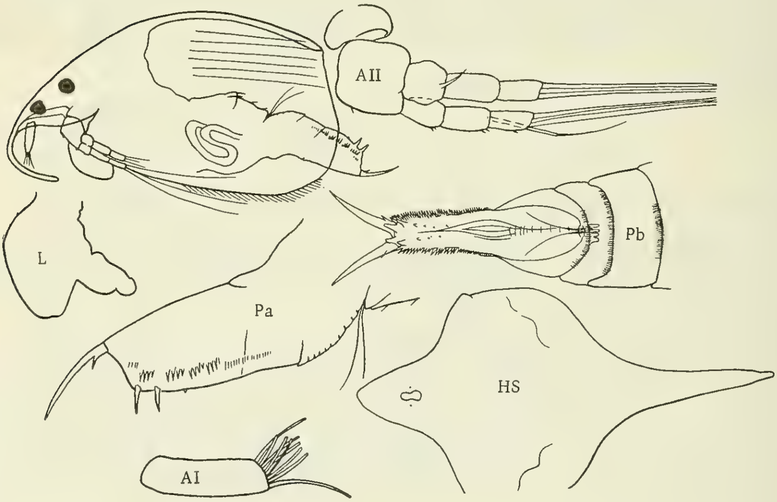

FIGURE 618. Rhynchotalona falcata, female, length 0.46 mm (Uglich Reservoir, 23 July 1962):

Pa – postabdomen; Pb – postabdomen, dorsal; HS – after Frey, 1962a.

and 2 setae on the dorsal side. Leg IV with oval exopodite with 6 setae. Leg V with oval exopodite with 4 setae. Leg VI in form of an oval lobe. Male smaller than the female, with modified leg I. One species.

1. **Rhynchotalona falcata** (Sars, 1862) (Figures 618–621)

Sars, 1862a:162 (Alona, Harporhynchus falcatus); P.E. Müller, 1867:183, Plate IV, Figures 13, 14 (Alona); Norman and Brady, 1867:387, Plate XVIII (Lynceus falcatus); Hellich, 1877:94, Figures 52, 53 (Alona); Birge, 1893:305, Plate XIII, Figures 9, 10 (Alona); Lilljeborg, 1900:488–492, Plate LXIX, Figures 22–26, Plate LXX, Figures 1–5 (Leptorhynchus falcatus); Herr, 1917:112–113, Figure 36; Bening, 1941:274–275, Figure 113; Frey, 1959:36, Figure 21; 1962a, Figure 21; Šrámek-Hušek et al., 1962:352–354, Figure 131; Herbst, 1962:90, Figure 70.

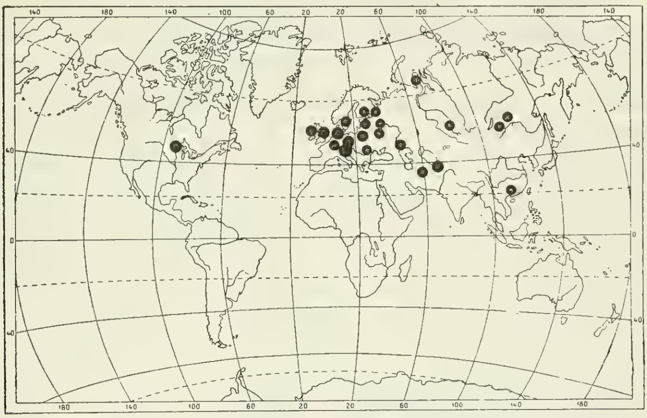

FIGURE 619. Distribution of Rhynchotalona falcata

Material. Numerous females from the Uglich and Rybinsk reservoirs; 3 females from Lake Muolan-Yarvi on the Karelian Isthmus; 1 female from the Vychegda River; 3 females from Lake Karga (Chita Region); numerous males from the Rybinsk Reservoir. Preparations: MGU – female 715, ephippial female 1926, male 51. ZIN – female 540, ephippial female 2022, male 50. Ph – female 1732, male 1976.

Female. Posterodorsal corner of valves only slightly below highest dorsal point. Posteroventral corner with a denticle. Ventral margin with setae, anterior setae longer. Rostrum very long, curved posteriorly. Two main head pores with a broad connection between them. Valves with lines. Posterior margin of antennules with a sensory seta distal to the middle.
491 Antennae with a lateral seta at the base. Proximal segment of exopodite and both distal segments with spines. Exopodite with thick proximal segment. Each segment of endopodite with 1–2 setae on the outer margin. Distal segments with 3 setae, one seta half as long as the others. Setae on antennae: 0–0–3/0–1–3. Plate of labrum rounded. Abdominal segments with setae (Figure 618).

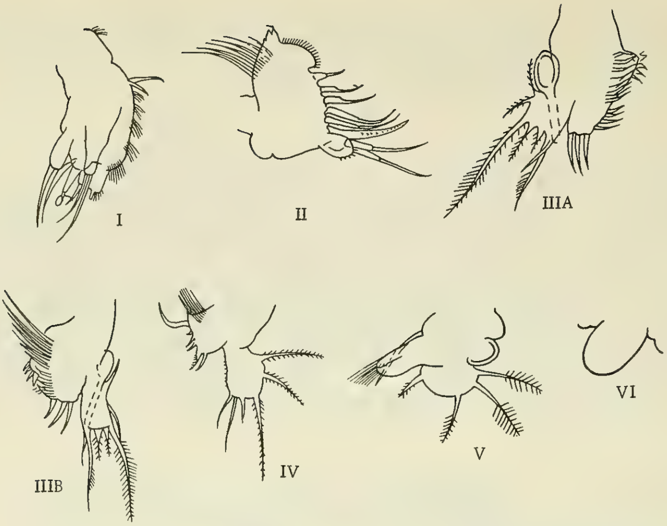

FIGURE 620. Legs of female of Rhynchotalona falcata (Uglich Reservoir, 23 July 1962):

I, II, V, VI – left legs, outer side; III – left leg, inner side; IIIB, IV – right legs, inner side.

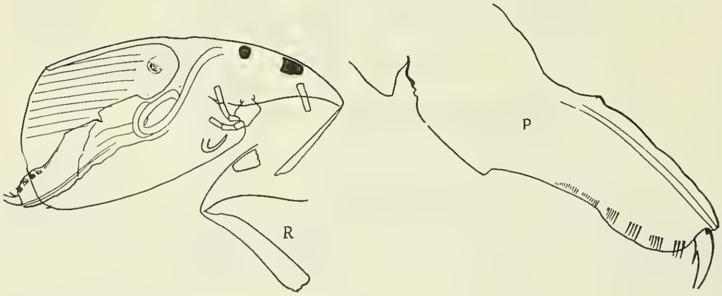

FIGURE 621. Rhynchotalona falcata, male, length 0.33 mm (Rybinsk Reservoir, Borok, 20 September 1965, preparation 51):

R – preparation 50; P – preparation 51.

Dorsal margin of postabdomen with incisions in proximal part of anus between natatorial setae and angular process. Distal part of dorsal margin of postabdomen with 4–5 anal denticles, the distal denticles much larger, the proximal denticles small and indistinct in lateral view. Lateral row of setae extending from base of claws to proximal margin of anus. Eye and ocellus of about equal size. Ocellus situated nearer to eye than to apex of rostrum. Legs typical for the subfamily. Length to 0.55 mm.

Male. Posterodorsal corner of valves at level of dorsal margin of valve. Valves with convex posterior margin. Posteroventral corner with a denticle. Rostrum slightly widened distally with an incision at the apex. Anterior margin of antennules with a distal flagellum, posterior margin with a sensory seta and a papilla distally. Other sensory papillae situated on distal margin. Postabdomen without anal denticles. Row of lateral setae extending from distal end of postabdomen to anus. Claws with a basal spine. Leg I with a hook; outer branch of endite with 3 setae of nearly equal length. Vas deferens opening at base of claws, ventral to them. Ocellus larger than eye. Length to 0.4 mm.

Distribution. Holarctic Region. European USSR, Chita Region.

Biology. Inhabits the bare littoral.

Species incertae sedis

Rhynchotalona dentata (P. E. Müller, 1867). P. E. Müller, 1867: 179–180, Plate IV, Figures 6–7 (Alona dentata).

According to Hellich (1877) this is Rhynchotalona falcata with broken rostrum. However, it should be remembered that the genus Leydigiopsis contains not only species with a long, posteriorly curved rostrum but also species with a rostrum which is short and directed ventrally.

Rhynchotalona polonica (Dybowski and Grochowski, 1895:151) (Harporhynchus polonicus). Nomen nudum.

Rhynchotalona striata Borutskiy and Bogoslovskiy, 1964. Borutskii and Bogoslovskii, 1964:109, 111, 113, 114. Nomen nudum.

22. Genus Oxyurella Dybowski and Grochowski, 1894

Dybowski and Grochowski, 1894:381; Daday, 1905:178 (Euryalona part); Birge, 1910:1045 (Odontalona); Bening, 1941:292–293 (Oxyurella); Bergamin, 1941:162.

Type species: Oxyurella tenuicaudis (Sars, 1862).

Body oval. Posteroventral corner of valves rounded, without denticles. Rostrum blunt. Two separated head pores; one small pore lateral to the main pores, two small pores between the main pores (as described for O. longicaudis [Frey, unpublished data], O. tenuicaudis, O. singalensis). Antennules not reaching apex of rostrum. Setae on antennae: 0–0–3/1–1–3. Postabdomen with anal denticles; 2–3 distal teeth distinctly larger than the others and with lateral setae. Claw with a diverging basal spine situated some distance from base of claws. Postabdomen slightly tapering distally. Intestine forming loops, with a caecum. Ocellus slightly smaller than eye.

Leg V with a row of setae on anterior side of endite. Leg II of normal structure. Leg III with square exopodite with 7 setae, seta 7 much longer than the others. Leg IV with rounded exopodite with 6 setae. Leg V with large oval exopodite with 4 setae, one of them small and situated on the anterior side, the other three on the posterior side.

Male smaller than the female. Vas deferens opening ventrally at base of claws.

Key to Species of the Genus Oxyurella according to Females

1 (8). Claw with one basal spine.
2 (7). Anal denticles irregularly increasing in size distally.
3 (6). Distal anal denticles much longer than the others.
4 (5). Plate of labrum not pubescent . . . . . 1. **O. tenuicaudis** (Sars, 1962).
5 (4). Plate of labrum pubescent . . . . 2. **O. ciliata** Bergamin, 1939.
6 (3). Two distal anal denticles long, 3 following denticles shorter than the adjacent ones, then a row of denticles decreasing gradually in
493 size . . . . 3. **O. longicaudis** (Birge, 1910).
7 (2). Anal denticles regularly increasing in size distally . . . . 4. **O. wallaciana** (Henry, 1919).
8 (1). Claw with one large spine and several small accessory basal spines . . . . 5. **O. singalensis** (Daday, 1898).

Key to Species of Known Males of the Genus Oxyurella

1 (2). Antennules not reaching apex of rostrum . . . . . . 1. **O. tenuicaudis**.
2 (1). Antennules reaching apex of rostrum . . . . 5. **O. singalensis**.

1. **Oxyurella tenuicaudis** (Sars, 1862) (Figures 622–625)

Schoedler, 1858:27 (Camptocercus alonoides, (without description or drawings); Sars, 1862b:285–286 (Alona); Schoedler, 1862:24, Plate I, Figures 8, 9, 10 (Alona camptocercoides); 1863:24–25, Plate I, Figures 8, 9, 10 (Alona camptocercoides); Norman and Brady, 1867: 25, Plate XIX, Figure 3 (Lynceus); P. E. Müller, 1867:179, Plate II, Figure 20, Plate III, Figure 24 (Alona); Matile, 1890:43–44, Figure 33 (Alona); Klocke, 1893:386 (Alona fennicaudis); Dybowski and Grochowski, 1895:151; Lilljeborg, 1900:461–465, Plate LXVIII, Figures 2–8 (Lynceus); Daday, 1905:178, Plates 11, 12, 13 (Euryalona); Birge, 1910: 71, Figures 5, 6 (Odontalona); Bening, 1941:293–295, Figure 121; Harding, 1957b:74–75, Figures 17, 18, 19; Brehm, 1959b:7; Frey, 1960:695, Figure 11; Šrámek-Hušek et al., 1962:332–333, Figure 122 (Alona); Herbst, 1962:86–88, Figure 62 (Alona); Goulden, 1966b:93, Plate I, Figure 11.

Material. Numerous females from the Ivan'kovo Reservoir, Shumarovka River (tributary of the Rybinsk Reservoir), ponds of the Yakot'

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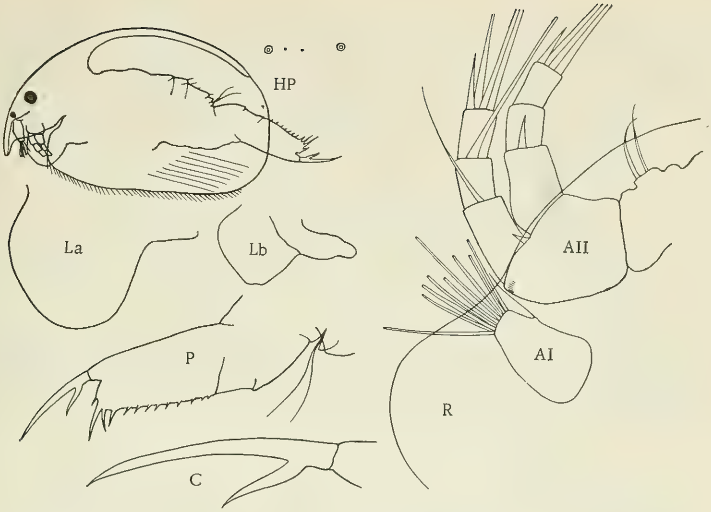

FIGURE 622. Oxyurella tenuicaudis, female, length 0.44 mm:

HP, La — Shumorovka River, 2 August 1962; Lb — Ivan'kovo Reservoir, 21 July 1962; P, C — Shumorovka River, 2 August 1962; R, AI, AII — rostrum with antenna and antennule, dorsal (Ivan'kovo Reservoir, 21 July 1962).

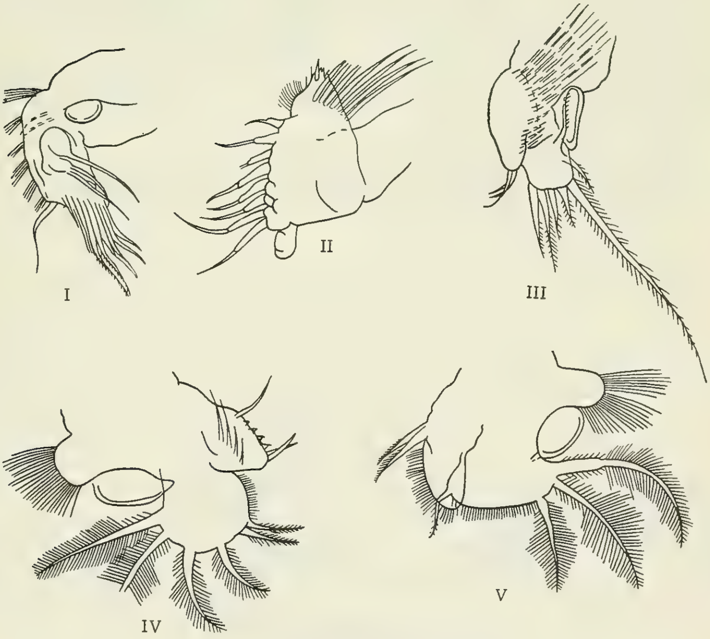

FIGURE 623. Legs of female of Oxyurella tenuicaudis (Ivan'kovo Reservoir, 21 August 1962):

I, III — left legs, outer side; II, IV — left legs, inner side; V — right leg, outer side.

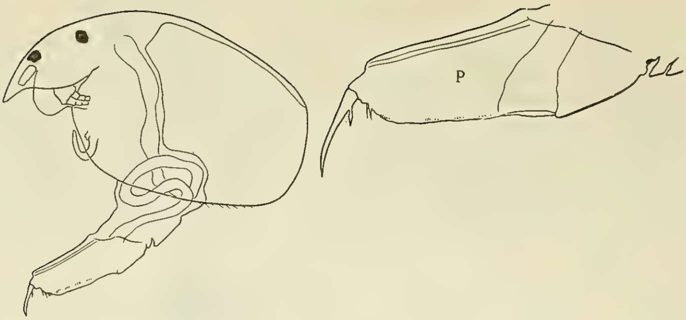

FIGURE 624. Oxyurella tenuicaudis, male, length 0.37 mm (southwestern Kyzylkum, 45 km from Nurata, 20 October 1962, preparation 2165)

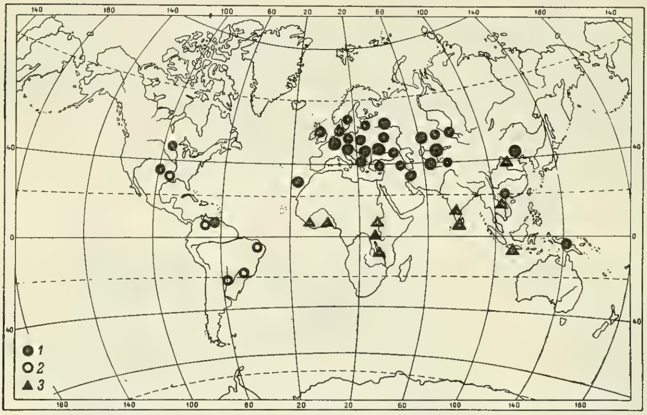

FIGURE 625. Distribution:

1 – Oxyurella tenuicaudis; 2 – O. longicaudis; 3 – O. singalensis.

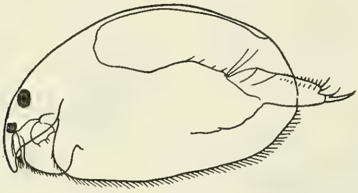

FIGURE 626. Oxyurella ciliata, female (after Bergamin, 1941)

fish farm, southwestern Kyzylkum; one female from Lake Kravtsevo in the Stavropol' Territory; 2 females from the Terek delta; several females from lakes in the Aktyubinsk and Dzhambul regions. Two males from the southwestern Kyzylkum. Preparations: MGU – female 634, female with retained molted valves 636, male 2165. ZIN – female 632, male 2166.

Female. Posterodorsal corner of valve slightly below highest point of dorsal margin. Posteroventral corner rounded, with a row of spinules on the inner side. Valve with longitudinal lines. Ventral margin of head S-shaped. Rostrum short, slightly pointed, directed ventrally. Two main head pores situated in median line of head shield; 2 small pores between the main pores, 2 additional pores lateral to the small pores. Some specimens retain the discarded valves (Ivan'kovo Reservoir, 21 July 1962 preparation 636). Antennules not reaching apex of rostrum. Setae on antennae: 0–0–3/1–1–3; spines: 1–0–1/0–0–1. Proximal segment of endopodite of antenna with a short seta which is, however, longer than the segments of the endopodite. Labrum broadly rounded.

Ratio of length:width of postabdomen about 3. Postabdomen narrowing distally. Anal denticles 10–20, the last denticle followed by a small spinule near the claws. Distal anal denticles very large. Small groups of lateral setae. Claws with a long basal spine. Ocellus smaller than eye, situated nearer to eye than to apex of rostrum. Legs closely resembling those of species of Alona. Outer branch of endite of leg I with 3 setae of different length (Figure 116, B). Exopodite of leg I with a seta which is longer than the longest seta on the outer branch of the endite. Length 0.6 mm.

Male. Posteroventral and posterodorsal corner of valve rounded. Valve with longitudinal lines. Antennules not reaching apex of rostrum. Anterior margin of antennules with a flagellum distally. Postabdomen without anal denticles, with lateral setae. Claw S-shaped, with a basal spine. Vas deferens opening ventrally at base of claws. Ocellus smaller than eye. Length to 0.45 mm.

Distribution. Holarctic Region. European USSR, to the basin of the Lena and the Syrdar'ya in the east.

Biology. Monocyclic regardless of duration of vegetation season (Vereshchagin, 1912b).

2. **Oxyurella ciliata** Bergamin, 1939 (Figure 626)

Bergamin, 1931. MS. Estudio systematico des Cladocera des aquas do municipio de S. Paulo. Thèse inaugural; Bergamin, 1939, Plate II, Figure 3; 1941:162–163, Figure 1.

Material. According to description.

Female. Body oval. Valve with rounded posterodorsal and posteroventral corner. Antennules not reaching apex of rostrum. Plate of labrum broadly rounded, with setae on the anterior margin. Anal denticles 15–16. Lateral setae present. Length 0.44 mm.

Male. Unknown.

Distribution. São Paulo (Brazil).

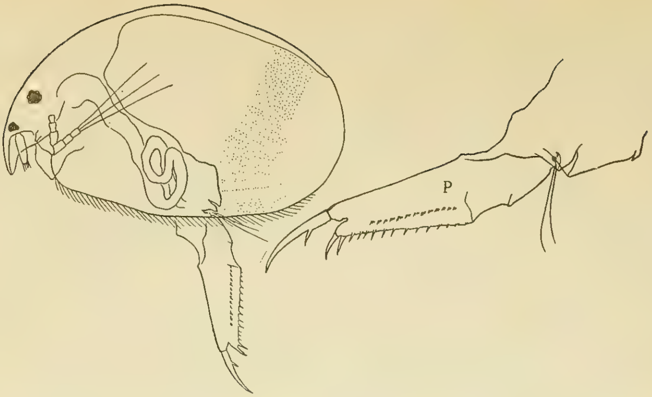

FIGURE 627. Oxyurella longicaudis, female, length 0.71 mm (Corrientes, Argentina, January 1967, preparation 1978)

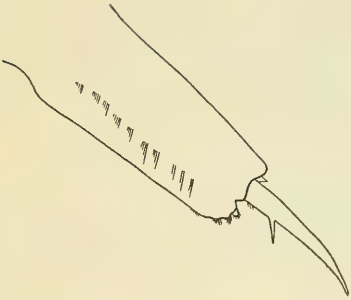

FIGURE 628. Postabdomen of male of Oxyurella longicaudis (after Brehm, 1938a)

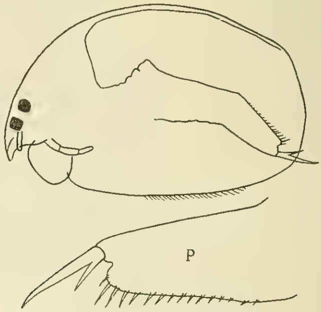

FIGURE 629. Oxyurella wallaciana, female (after Henry, 1919)

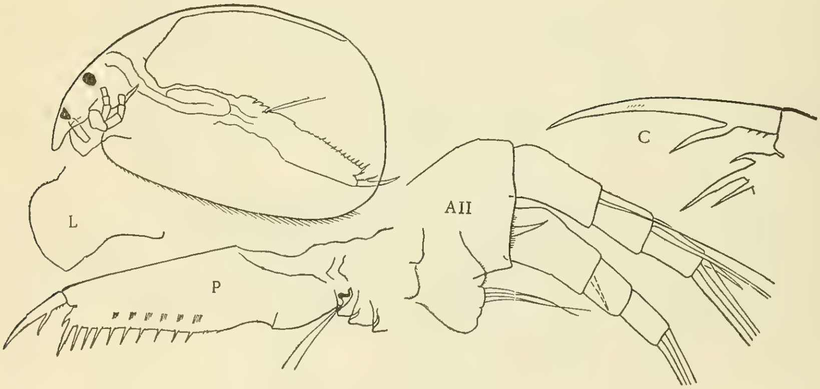

FIGURE 630. Oxyurella singalensis, female (Lake No, White Nile, 15 February 1964): L, P, C — preparation 2064; AII — left antenna, inner side.

496 3. **Oxyurella longicaudis** (Birge, 1910) (Figures 625, 627, 628)

Daday, 1905:178–180, Plate XI, Figures 12, 13 (Euryalona tenuicaudis); Birge, 1910:1045–1048, Plate LXXI, Figures 3, 4, 7 (Odontalona); Brehm, 1938a:100, Plate 5; 1956:225, Plate 3; Goulden, 1966b:93, Plate I, Figure 10.

Material. Five females from Corrientes (Argentina). Preparations: MGU – female 1978. ZIN – female 1340 (with not discarded valve).

Female. Rostrum pointed. Antennules not reaching apex of rostrum. Esthetascs of uniform length. Plate of labrum with pointed apex. Postabdomen long, narrowing distally. Anal denticles about 16, long, short proximally. Two distal denticles much longer than the others, terminal denticle with setae on the concave margin. The following 3 denticles slightly shorter than the others. Lateral groups of setae present, but not in lateral part of postabdomen (Figure 627). Claw with a basal spine situated at $^1/_3$ of length of claw from the base. Ocellus smaller than eye, situated nearer to the eye than to apex of rostrum. Length 0.62 mm.

Male. Postabdomen without anal denticles, with groups of lateral setae. Claw with one basal spine, with setae proximal to the spine.

Distribution. Neotropical Region.

4. **Oxyurella wallaciana** (Henry, 1919) comb. n. (Figure 629)

Henry, 1919:472–474, Plate XLI, Figures 7, 8 (Alona).

Material. According to description.

Female. Posterodorsal and posteroventral corner rounded. Valves irregularly punctate. Ventral margin of valve with setae. Antennules not reaching apex of rostrum. Plate of labrum rounded. Postabdomen narrowing distally. Anal denticles about 15, decreasing in size proximally. Claw with a basal spine half as long as the claw. Ocellus as large as eye, situated nearer to eye than to apex of rostrum. Length 0.49 mm.

Male. Unknown.

Distribution. Southeast Australia.

497 5. **Oxyurella singalensis** (Daday, 1898) (Figures 625, 630–632)

Daday, 1898:43–45, Figure 20 (Alonopsis); 1910b:135–136, Plate 7, Figures 21, 22 (Alonopsis); Grochmalicki, 1915:226–227, Plate 6, Figures 8a, b (Alonopsis lomnicki); Brehm, 1934a:66, Figures 12, 13 (Alona gauthieri); 1953b:338–339, Plates 103–105 (lindbergi).

Material. Numerous females from the White Nile. Preparations: MGU – female 2064. ZIN – female 2065. Ph – female 2067.

Female. Valve with dots and with lines parallel to the ventral margin. Antennules almost reaching apex of rostrum. Esthetascs of almost equal length, slightly shorter than antennule. Setae on antennae: 0–0–3/1–1–3; spines 0–1–0/0–0–1 (Figure 630). Plate of labrum with slightly pointed apex, anterior margin not pubescent. Two separate main head pores, situated behind each other in median line of head shield. Four small pores, 2 of them between the main pores; 1 behind the other, the other 2 laterally about halfway between the main pores. Distance between small lateral pores about equal to that between the main pores.

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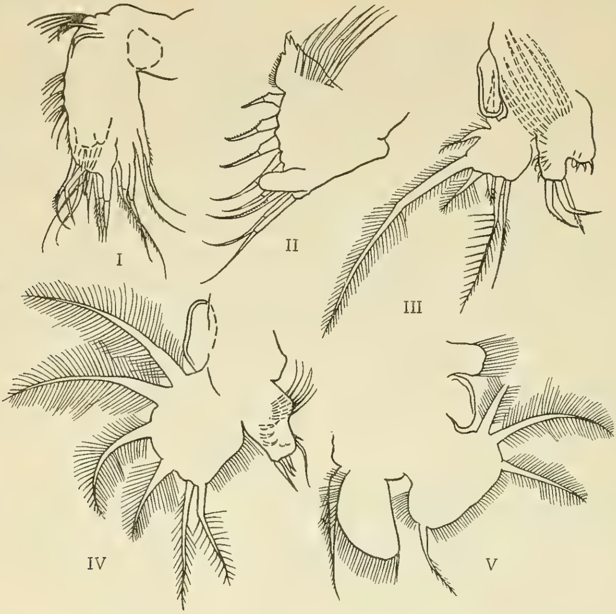

FIGURE 631. Legs of female of Oxyurella singalensis (Lake No, White Nile, 15 February 1964):

I — right leg, inner side; II, III, IV — right legs, outer side; V — left leg, outer side.

Postabdomen slightly narrowing distally. Distal anal denticle the longest, followed distally by a short curved denticle. To 16 anal denticles, decreasing in size proximally. A small denticle distal to this row. Lateral setae present. Claws with 3–4 basal spines. Ocellus half as large as eye, about twice as near to the eye as to apex of rostrum.

Leg I with transverse rows of setules on the anterior side, distal setules thicker. Epipodite of leg I without process, as on the other legs. Leg II with oblong exopodite. Three of the scraping setae of leg II are short and pectinate, and 5 are longer and thin. Leg III with square exopodite with 7 setae. Posterior side of exopodite with 5 setae, anterior seta sparsely pubescent and slightly shorter than the second seta. Second seta feathered,

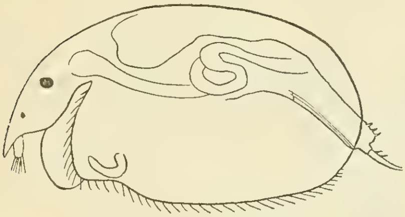

FIGURE 632. Oxyurella singalensis, male (after Daday, 1898)

with sparse setules. Third seta very short. The following seta slightly longer, fifth seta very large and long. Dorsal side of exopodite with 2 short setae pointing in different directions. Leg IV with a large round exopodite with 6 setae. Leg V with an oval exopodite with 4 setae, the anterior seta relatively small, sparsely pubescent. Length to 0.9 mm.

Male. Antennules reaching to apex of rostrum. Ventral margin of valves with a convexity in the middle; short marginal setae before the convexity, longer setae behind it. Valves indistinctly punctate. Postabdomen uniformly wide, with a narrow incision at the base of the claws. Anal denticles 3, at the rounded dorsal end of the postabdomen. Ocellus distinctly smaller than eye. Length to 0.5 mm.

Distribution. Ethiopian and Indo-Malayan regions, Northeast China.

Nomina nuda

Oxyurella goplana Dybowski and Grochowski, 1895:151.

Oxyurella lithuanica Dybowski and Grochowski, 1895:151.

Oxyurella tenuicaudis var. polonica Dybowski and Grochowski, 1895:151.

23. Genus Euryalona Sars, 1901

Daday, 1898:45 (Alonopsis); Sars, 1901:80–81; Daday, 1910b:134; Sars, 1916:341.

Type species. Euryalona orientalis (Daday, 1898).

Posterodorsal and posteroventral corner of valves rounded, without denticles. Valve with indistinct sculpture. Head shield with blunt rostrum 498 and rounded posterior margin. One main pore. Postabdomen narrow, with anal denticles and lateral setae. Anus situated in proximal part of postabdomen. Ocellus smaller than eye.

Male smaller than the female. Vas deferens opening in middle of ventral side of postabdomen.

Key to Species of the Genus Euryalona according to Females

1 (4). Postabdomen slightly curved.
2 (3). Ventral margin of valves slightly concave . . . . 1. E. orientalis (Daday, 1898).
3 (2). Ventral margin of valves deeply concave . . . . 2. E. fasciculata Daday, 1905.
4 (1). Postabdomen not curved . . . . 3. E. brasiliensis Brehm and Thomsen, 1936.

1. Euryalona orientalis (Daday, 1898) (Figures 116, 633–637)

Daday, 1898:45–48, Figures 21, 22 (Alonopsis orientalis); Sars, 1901:81–84, Plate XII, Figures 1, 1a–h (occidentalis); Daday, 1905:180–181, Plate XI, Figures 14, 15 (orientalis); 1910b:134–135, Plate 7, Figures 18, 19, 20 (orientalis); Gauthier, 1930:100–101, Figure (orientalis); Brehm, 1939a:8–9; 1951c:85, Figures 1e, f, g; Harding, 1957b:73–74, Figure 16 (occidentalis).

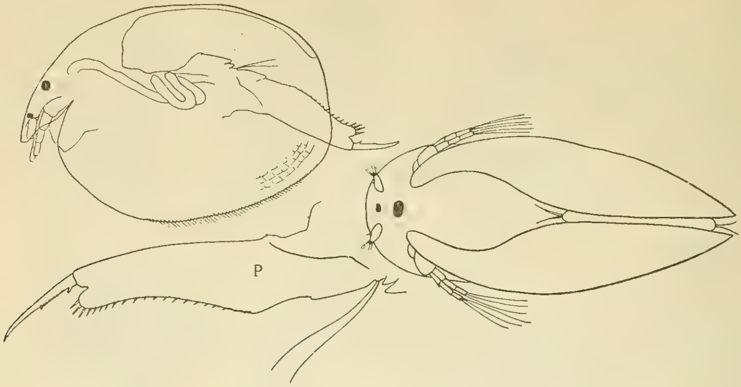

FIGURE 633. Euryalona orientalis, female, length 0.79 mm (White Nile, Um-Arda, 11 April 1964, preparation 1950):

P – postabdomen, ventral, after Sars, 1901.

Material. Numerous females from upper reaches of White Nile; 4 females from Corrientes (Argentina). Preparations: MGU – female 1950. ZIN – female 1018. Ph – female 1795.

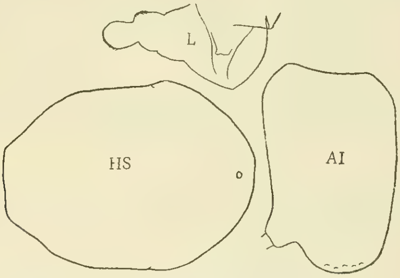

FIGURE 634. Euryalona orientalis, female:

L, AI – White Nile, at Tonga, 2 January 1949; HS – after Frey, 1965a.

Female. Posteroventral corner of valves rounded, without denticles. Ventral margin with a blunt process before the middle. Margins of valves with several concentric rows of weak dots. Anterior margin of valves with
499 short setae. Middle of ventral margin of valves with strong setae beginning

some distance from the margin. Head shield with blunt anterior and rounded posterior margin. A single main head pore which is sometimes absent, small pores situated lateral to the main pore (Frey, 1965). Antennules reaching apex of rostrum. Plate of labrum with convex anterior margin and blunt apex. Postabdomen narrow, slightly curved. Preanal corner distinct. Distal end of postabdomen with a rounded process separated by an incision from the base of the claws. About 20 anal denticles, decreasing in size proximally. Claws with setae on proximal half of concave part and with a basal spine. Ocellus situated halfway between eye and apex of rostrum.

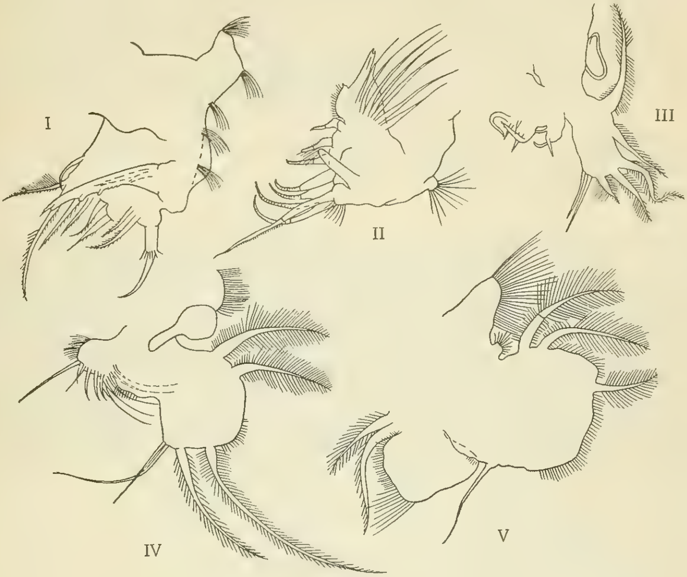

FIGURE 635. Legs of female of Euryalona orientalis (White Nile):
I, II – right legs, outer side; III, IV, V – left legs, outer side.

Leg I with transverse rows of setae on anterior side of endite. Outer branch of endite with 3 setae of different length (Figure 116, D). The large seta strongly chitinized, with denticles on the concave side. Exopodite of leg I with a seta which is much longer than the longest seta on the outer branch of the endite. Leg II with an elongate exopodite with an apical group of setae. The longest of the setae on the endite of leg II (near ventral
01 margin of valve) is straight, brushlike, with setules directed toward ventral side of valve. Following 4 setae curved, moderately long. The 3 setae near the gnathobase pectinate, gradually decreasing in length. Gnathobase narrow, oblong. Leg III with oval exopodite with 5 setae on the posterior side and 2 setae on the dorsal side. Both anterior setae on the posterior margin slightly pubescent. Seta 7 large. Leg IV with rounded exopodite with 5 setae. The 2 anterior setae bare, then follow 2 long feathered setae and after a long interval another 2 feathered setae

(shorter than the preceding two). Leg V with rounded exopodite with 3 feathered setae on the posterior side. Anterior side of exopodite with long thin, not feathered seta (not illustrated by Sars, 1901). Length to 1 mm.

(499)

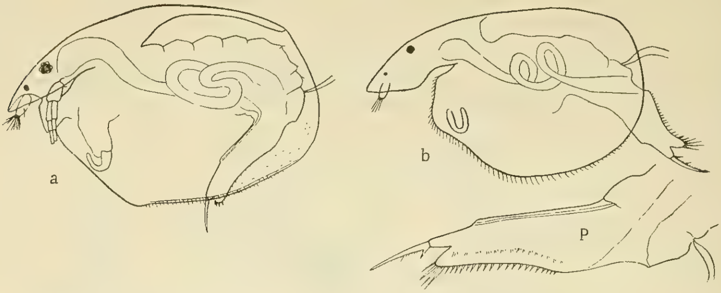

FIGURE 636. Euryalona orientalis, male:
a – after Sars, 1901; b, P – after Daday, 1898.

Male. Posteroventral corner of valves rounded, without denticles. Ventral margin of valves with a convexity before the middle; margin of valve curving anterodorsally before the convexity. Antennules reaching to apex of rostrum. Postabdomen slightly curved. Preanal corner distinct. Anal margin concave. Anal denticles and lateral setae present. Claws with setae on the concave margin and with a basal denticle. Vas deferens opening ventrally, some distance from base of claws. Length 0.7 mm.

Distribution. Indo-Malayan, Ethiopian, Neotropical regions; shore of Gulf of Mexico; Northeast China.

2. Euryalona fasciculata Daday, 1905 (Figure 638)

Daday, 1905:181–183; Plate XII, Figures 5–10.

Material. According to description.

Female. Valves with granulate surface. Posterodorsal and posteroventral corner of valves rounded. Posterior margin of valves convex. Antennules almost reaching apex of rostrum. Sensory seta situated on a process on the outer margin. Antennae with 7 setae. Plate of labrum with rounded apex. Postabdomen narrowing distally. Posterodorsal corner of postabdomen produced, with 5–6 long denticles; proximal to them a group of anal spinules. Fourteen–sixteen groups of setae laterally. Claws slightly curved, with hairs on the whole concave margin and a larger seta in the middle. One basal spine. Length to 0.9 mm.

Male. Anterior margin of valves with a rounded convexity. Antennules almost reaching apex of rostrum. Postabdomen with 7 spines on the produced posterodorsal corner. Anal denticles 14, accompanied by 1–2 setae. Vas deferens opening ventrally, some distance from the base of the claws. Length to 0.6 mm.

Distribution. Paraguay.

500)

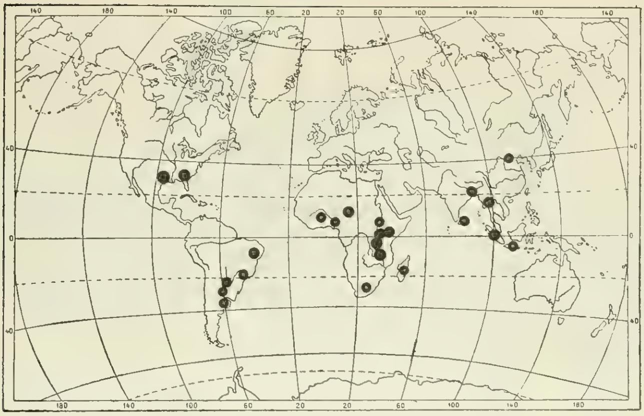

FIGURE 637. Distribution of Euryalona orientalis

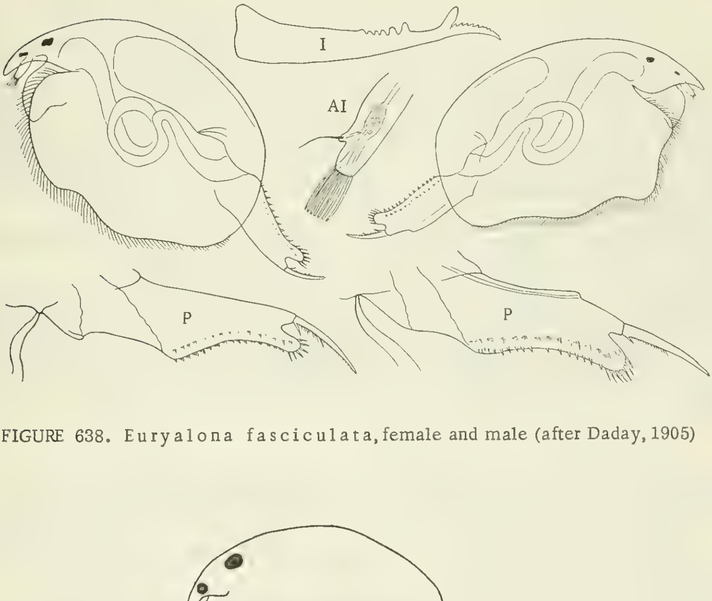

FIGURE 638. Euryalona fasciculata, female and male (after Daday, 1905)

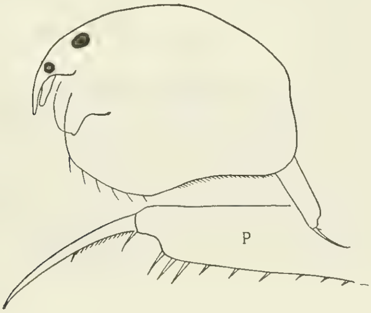

FIGURE 639. Euryalona brasiliensis, female, (after Brehm and Thomsen, 1936)

3. Euryalona brasiliensis Brehm and Thomsen, 1936
(Figure 639)

Brehm and Thomsen, 1936:215–216, Plates 3, 4.

Material. According to description.

Female. Antennules not reaching apex of rostrum. Ventral margin of valves with a few large setae in the anterior half. Postabdomen narrowing distally, not curved. Lateral setae absent. Anal denticles 8–9, 3 distal denticles large. Dorsal distal corner of postabdomen not produced. Concave side of claw with a row of setae ending in a larger seta in middle of claw. Hook-shaped seta on leg I without denticle in the middle.

Male. Unknown.

Distribution. Recife (Brazil).

24. Genus Indialona Petkovski, 1966

Petkovski, 1966:157–165.

Type species: Indialona ganapati Petkovski, 1966.

Head shield with rounded anterior and posterior margin and with a single main pore. Mandibles situated between head shield and valves. Postabdomen tapering toward base of claws without forming a dorsal corner. Postabdominal armature consisting of 4–5 groups of setae from the dorsal margin posteriorly and upward (i. e., on lateral surface of postabdomen). Claws with one basal spine. The systematic position of this genus is doubtful because of the insufficient description of the legs.

We place in this genus some forms with a high body and characteristic head pores which are little known but are apparently single.

These species resemble the type species in a number of characters, mainly the nearly circular body, the absence of denticles on the posteroventral corner of the valves, the tapering postabdomen, the claw with a single basal spine, and the fact that the antennules do not reach the apex of the rostrum.

502 Key to Species of the Genus Indialona according to Females

1 (4). Postabdomen tapering toward base of claws but forming a distal dorsal corner.
2 (3). Anal denticles absent. Rostrum short. . . . . 1. I. ganapati Petkovski, 1966.
3 (2). Anal denticles present. Rostrum long . . . . 2. I. annandalei (Daday, 1908) comb. n.
4 (1). Postabdomen with protruding distal dorsal corner.
5 (6). Anal denticles very small . . . . 3. I. globulosa (Daday, 1898) comb. n.
6 (5). Anal denticles large . . . . . . 4. I. macronyx (Daday, 1898) comb. n.

1. **Indialona ganapati** Petkovski, 1966 (Figure 640)

Petkovski, 1966:157–165, Plates 1–9.

Material. Many females from Ahmedabad (India). Preparations: MGU – female 2187. ZIN – female 1210. Baroda University (India, Professor S. V. Ganapati) female 2190.

Female. Valves with a pattern of small polygons. Posterior margin of valves about half maximum height. Posterodorsal corner distinct. Posteroventral corner rounded, without spinules. Ratio of length:height about 7.2:10. Valves with sparse setae on the ventral margin. Rostrum blunt. A single head pore, situated slightly farther from eye than distance between eye and ocellus. Antennules almost reaching apex of rostrum. Esthetascs of almost uniform length, as long as the rostrum. Setae on antennae: 0–0–3/1–1–3. Seta of proximal segment small, reaching to apex of third segment. Mandibles short, thick.

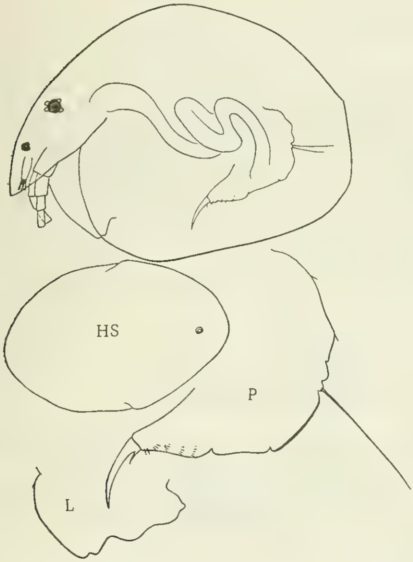

FIGURE 640. Indialona ganapati, female (after Petkovski, 1966)

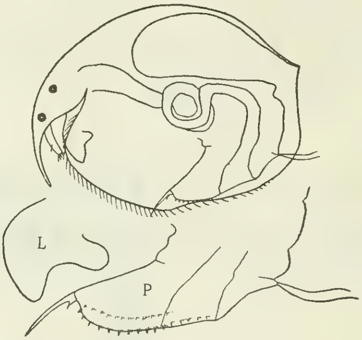

FIGURE 641. Indialona annandalei, female (after Daday, 1908a)

Preanal and postanal parts of postabdomen of almost equal size. Exopodite of leg IV 85μ wide, endite of leg IV also 85μ wide. Legs IV and V smaller than the preceding legs. Ocellus smaller than eye, situated halfway between eye and apex of rostrum. Length to 0.30 mm.

Male. Unknown.

Distribution. Ahmedabad (India).

2. **Indialona annandalei** (Daday, 1908) comb. n. (Figure 641)

Daday, 1908a:328–329, Figure 3 (Euryalona); Shen and Sung, 1964:64, 68 (Sinopleuroxus).

Material. According to description.

Female. Valves with projecting posterodorsal corner. Ventral margin produced before the middle. Surface of valves granulate. Antennule reaching to half of rostrum. Plate of labrum rounded. Postabdomen narrowing distally, with rounded apex. Anal spinules 12–14, accompanied 504 by small spinules. Lateral groups of setae present. Claw with a basal spine. Intestine forming loops. Ocellus situated nearer to eye than to apex of rostrum. Length to 1 mm. Placed provisionally in this genus until further study.

Male. Unknown.

Distribution. Eastern Tibet (only record in original description).

3. **Indialona globulosa** (Daday, 1898) comb. n.

Female. Body 1.3 times as long as high. Posterodorsal corner of valves distinct. Posteroventral corner rounded, without denticles. Rostrum blunt. Head shield with angular posterior margin. A single head pore. Head with undulate ventral margin (Figure 642). Plate of labrum with denticulate anterior margin and pointed apex. Postabdomen with distinct preanal corner. Anal margin concave, with setae. Anal denticles very small. About 11 lateral spines. Legs typical for the genus. Leg IV with rounded exopodite with 6 setae, seta 6 the smallest. Length to 0.4 mm.

Male. Unknown.

Key to Subspecies of I. globulosa according to Females

1 (2). Valve with distinct lines . . . 3a. **I. globulosa globulosa** (Daday, 1898).
2 (1). Valve with barely visible lines . . . . 3b. **I. globulosa insulcata** (Stingelin, 1905).

3a. **Indialona globulosa globulosa** (Daday, 1898) (Figures 642–644)

Daday, 1898:37–38, Figure 16 (Alona globulosa); Sars, 1901:63–64, Plate X, Figures 6, 6a (Alonella sculpta); Daday, 1905:165–166, Plate X, Figures 8, 9 (Alonella globulosa); Stingelin, 1905:353–354, Plate 12, Figures 24, 25 (Alona sculpta); Brehm, 1956:225–226, Figure 4 (Alona sculpta).

Material. Numerous females from the White Nile.

Female. Valves with distinct lines. According to Sars (1901), the lines are longitudinal in posterior half of valve, and transverse lines extend from the ventral line to the ventral margin of the valves; anterior half of valves with 6 lines parallel to anterior margin. Ventral margin of valves with a row of setae beginning behind the vertical lines.

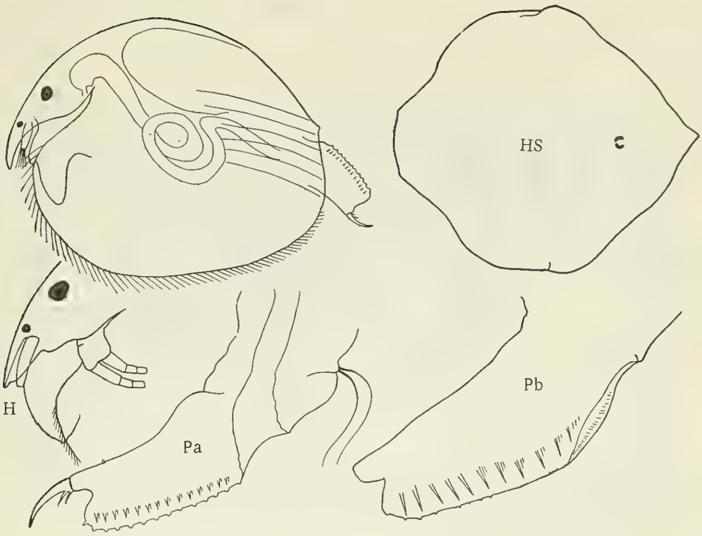

FIGURE 642. Indialona globulosa globulosa, female, left side:

Pa — after Daday, 1905; H, Pb — upper reaches of the White Nile at Tonga, 2 January 1949; HS — after Frey, 1965a.

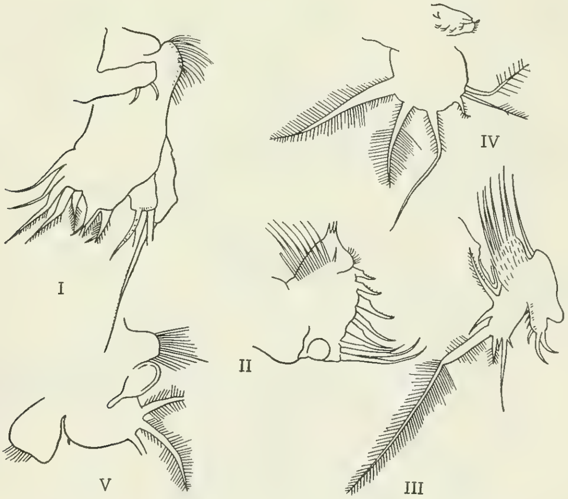

FIGURE 643. Legs of female of Indialona globulosa globulosa (upper reaches of the White Nile at Tonga, 2 January 1949):

I, IV — left legs, inner side; II — right leg, inner side; III — right leg, outer side; V — left leg, outer side.

Distribution. Indo-Malayan, Ethopian, Neotropical and Nearctic regions.

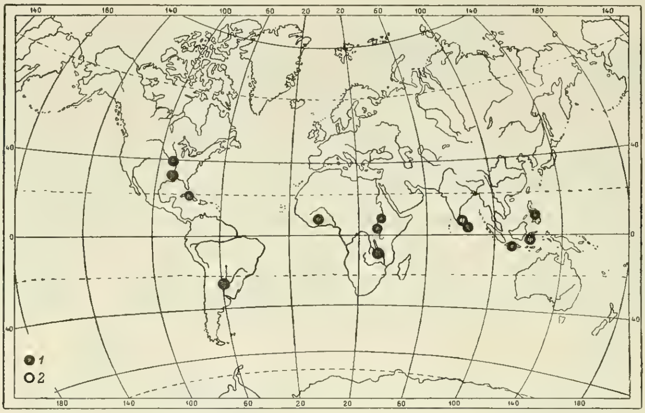

FIGURE 644. Distribution:

1 – Indialona globulosa globulosa; 2 – I. macronyx.

505 3b. **Indialona globulosa insulcata** (Stingelin, 1905)
(Figure 645)

Stingelin, 1905:354, Plate 12, Figure 26, Plate 13, Figures 27, 28 (Alonella sculpta var. insulcata); Daday, 1910b:123–124, Plate 6, Figures 11–13 (A. globulosa); Gauthier, 1951:75, Figures L, M (A. sculpta).

Material. Numerous females from the White Nile. Preparations: MGU – female 104. ZIN – female 112.

Female. Valves almost without sculpture. Posterodorsal corner distinct, posteroventral corner rounded. Arrow of feathered setae on inner side of valves. Rostrum blunt. Lateral margin of rostrum with a characteristic incision. Antennules ending less than their length before apex of rostrum. Distal segments of antennae almost reaching apex of rostrum. Plate of labrum with convex anterior margin and blunt apex. Anterior margin of plate of labrum with several small denticles.

Postabdomen narrowing distally. Anal denticles very small. Lateral setae in about 14 groups, distal setae projecting beyond margin of postabdomen. Anal margin concave, preanal corner distinct. Claw with a basal spine and setae on the concave side. Ocellus smaller than eye, situated slightly nearer to eye than to apex of rostrum. Length to 0.44 mm.

Distribution. White Nile, Senegal, Saigon.

4. **Indialona macronyx** (Daday, 1898) comb. n.
(Figures 644, 646)

Daday, 1898:35–37, Figure 15 (Alona).

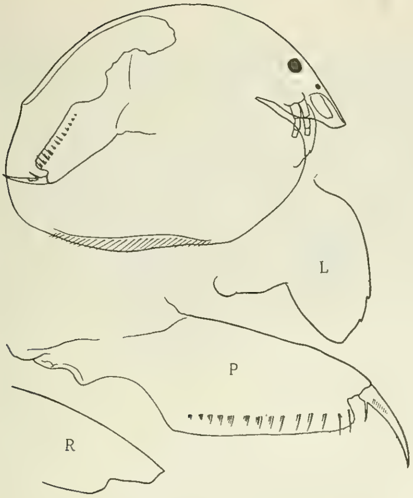

FIGURE 645. Indialona globulosa insulcata, female, length 0.44 mm (White Nile, 19 April 1964, preparation 104)

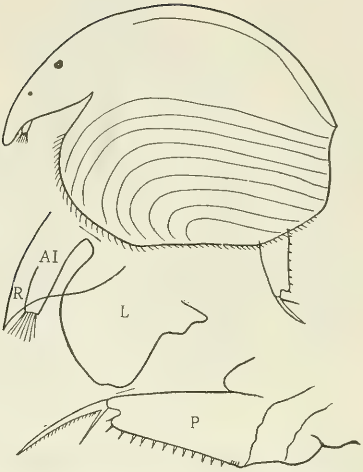

FIGURE 646. Indialona macronyx, female (after Daday, 1898)

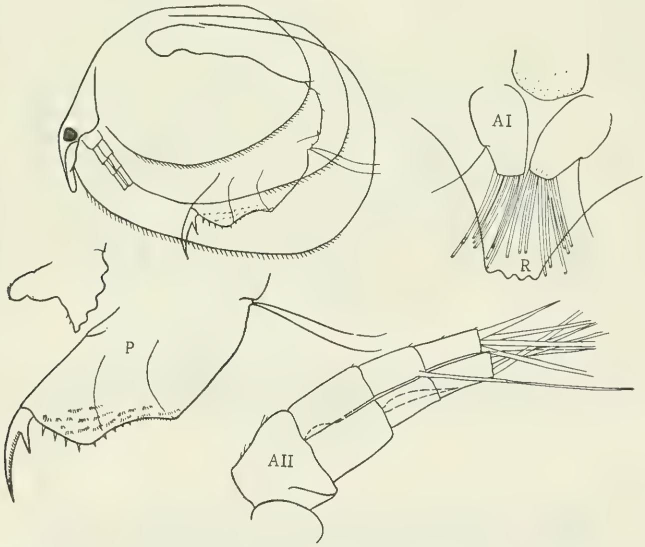

FIGURE 647. Monospilus dispar, female, length 0.36 mm (Uglich Reservoir, 23 July 1962)

Material. According to description.

Female. Body 1.3 times as long as high. Valves with distinct posterodorsal corner; posteroventral corner rounded, without denticles. Antennules not reaching apex of rostrum. Plate of labrum with convex margin and truncate apex. Ventral margin of valves slightly concave, with setae its whole length. Valve with lines which are connected in some places and with dots. Postabdomen narrowing distally, with an incision at the base of the claws. Anal denticles 12–14, large. Distal margin of postabdomen with a small denticle. Claw with a basal spine which is more than half as long as the claw and with setae on the concave margin. Intestine forming loops. Ocellus half as large as eye, situated nearer to eye than to apex of rostrum. Length 0.8 mm.

Male. Unknown.

Distribution. Indo-Malayan Region.

25. Genus Monospilus Sars, 1862

Fischer, 1854:427 (Lynceus part); Sars, 1862a:123; Schoedler, 1863: 75–76; Hellich, 1877:113; Herrick, 1884:119; Lilljeborg, 1900:578–580; Bening, 1941:339–340; Šrámek-Hušek et al., 1962:339–401; Herbst, 1962: 103–104.

Type species: Monospilus dispar Sars, 1862.

Body oval. Rostrum blunt. One head pore (Frey, 1959, 1962a). Reticulation of valves in form of cells and longitudinal grooves. Antennules not reaching apex of rostrum. Setae on antennae: 0–0–3/0–1–3; spines: 1–0–1/0–0–1. Plate of labrum with undulate anterior margin. Postabdomen short, with anal denticles. Postabdomen with 2 rows of groups of setae on each side. Claw with a basal spine. Intestine forming loops, with a caecum. Only ocellus present, eye absent. Molted valves usually not discarded, several margins of valves are therefore visible in form of concentric lines. A single valve in the 1st stage and in the autumn generation. Leg I with a row of setae on the anterior side. Leg II with 8 hook-shaped setae and a wide gnathobase. Leg III with square exopodite. Leg IV with a rather large exopodite with 6 setae. Leg V with oval exopodite with 4 setae.

Male smaller than female, with modified postabdomen and leg I. Leg I with a hook and a brush of setae opposite the hook on anterior side of endite. Vas deferens opening at base of claws, ventral to them.

1. Monospilus dispar Sars, 1862 (Figures 647–651)

Fischer, 1854:5, 427–428, Plate III, Figures 9–10 (Lynceus tenuirostris); Sars, 1862a:165–166; Norman and Brady, 1867:52, Plate XIX, Figure 2, Plate XX, Figure 9 (tenuirostris); P.E. Müller, 1867:196; Dybowski and Grochowski, 1895:153 (Kromaniensis syn.n., synonymized after examination of type material from the western Ukraine, at the L'vov University Zoological Museum, several specimens); Lilljeborg, 1900:581–584, Plate LXXVIII, Figures 26–31, Plate LXXIX, Figures 1–6; Brehm,

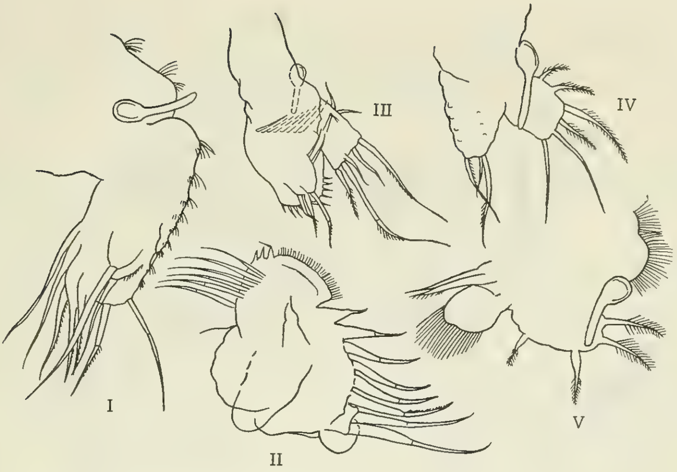

FIGURE 648. Legs of female of Monospilus dispar:

I – right leg, outer side; II, III – right legs, inner side; IV, V – left legs, outer side.

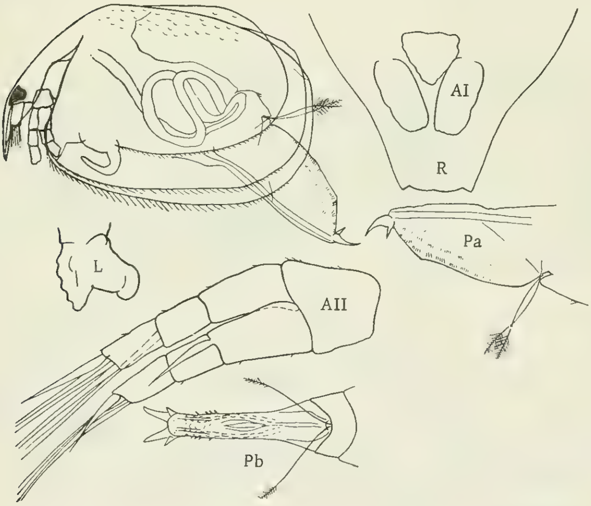

FIGURE 649. Monospilus dispar, male, length 0.34 mm (Rybinsk Reservoir, Borok, 20 September 1963, preparation 1298):

Pa – postabdomen; Pb – postabdomen, dorsal.

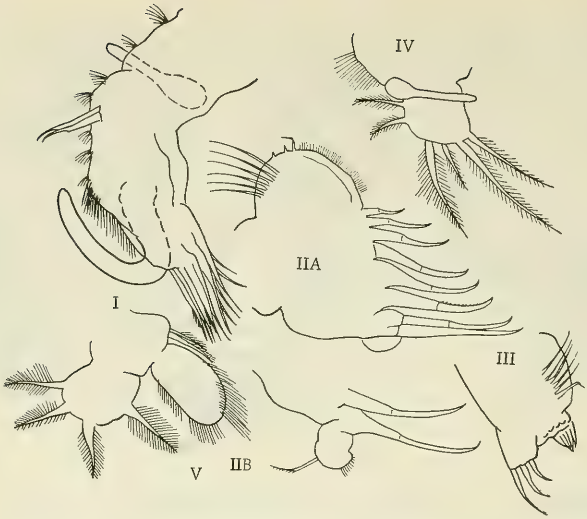

FIGURE 650. Legs of male of Monospilus dispar:

I, IIA, V — right legs, inner side; IIB — exopodite of right leg I, ventral; III — right leg, outer side (without exopodite); IV — right leg, outer side.

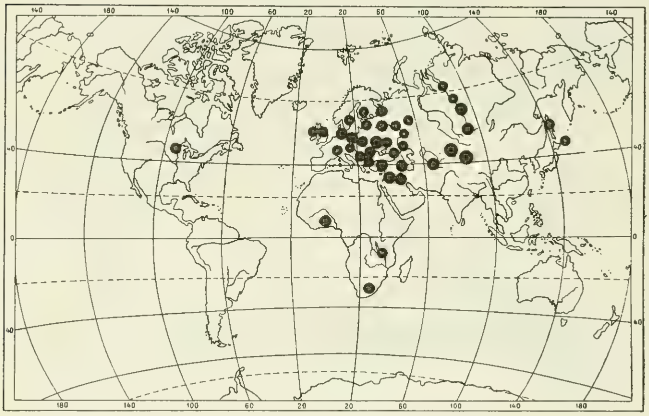

FIGURE 651. Distribution of Monospilus dispar

1934a:75–76, Figures 30, 31; Bening, 1941:340–342, Figure 142; Frey, 1959:41; 1962a, Figures 50, 51; Šrámek-Hušek et al., 1962:401–402, Figure 151; Herbst, 1962:104, Figure 92; Chiang Sieh-chih, 1964:83; Sebestyén, 1965:210–211, Plate 6; Negrea, 1966a:150.

509 Material. Numerous females from the Uglich and Rybinsk reservoirs; 2 females from southwestern Kyzylkum. Numerous males from the Rybinsk Reservoir. Preparations: MGU – female 1433, male 1298. ZIN – female 609, male 2008. Ph – female 183.

Female. Posterodorsal and posteroventral corner of valves rounded. Rostrum blunt, directed anteroventrally. In contrast to the valves the head shield is apparently shed during the molt. Antennules not reaching apex of rostrum. Anterior margin of antennules with a sensory seta in the middle. Setae on antennae: 0–0–3/0–1–3. Antennae with spines on proximal segment of exopodite and on both distal segments. Plate of labrum with convex and undulate anterior margin; inner margin with several setae. Maxillules with 3 pubescent setae, one of them smaller than the others. Postabdomen short. Preanal margin as long as postanal and anal margin together. Preanal corner protruding but not pointed. Anal margin with spinules, with several groups of setae laterally. Dorsal distal margin of postabdomen with 5–7 anal denticles and several lateral groups of setae. Claw with setae on the concave margin and with a basal spine. Fischer (1854) stated that young M. dispar have both an eye and an ocellus and that the ocellus disappears with age. However, examination of developed embryos showed that only an ocellus is present. Leg I with rows of setae on anterior surface of endite. Leg II with wide gnathobase with a row of hairs on the posterior margin. Legs III and IV with small exopodites. Leg V with an oval exopodite. Length, according to material from the Rybinsk Reservoir, 10 Aug. 1960, 0.28 (1st stage) to 0.47 mm, minimum length of gravid specimens 0.35 mm (3rd stage).

Male. Height relatively lower than in the female. Posterodorsal and posteroventral corner of valves rounded. Rostrum blunt. Antennules not reaching apex of rostrum. Antennules with a 2-segmented flagellum proximal to middle of anterior margin and with a sensory seta distal to the middle. Setae on antennae: 0–0–3/0–1–3. Plate of labrum with undulate anterior margin.

Postabdomen short, narrowing. Preanal corner not protruding. Anal denticles absent. Postabdomen with groups of lateral setae in 2–3 rows. Claws with setae on the concave margin and with a basal spine. Leg I with transverse rows of setules on anterior side of endite. Hook present; a brush of hard setae distally on anterior side of endite opposite apex of hook. Outer branch of endite of leg I with 3 setae of uniform structure (Figure 127). Exopodite of leg I with a thin seta which is much longer than the longest seta on the outer branch of the endite. Vas deferens opening ventrally at base of claws.

Distribution. Holarctic and Ethiopian regions. European USSR, Kyzylkum, Balkhash, Sakhalin and Kunashir Island.

Biology. Inhabits the bare littoral. Molted valves usually not discarded.

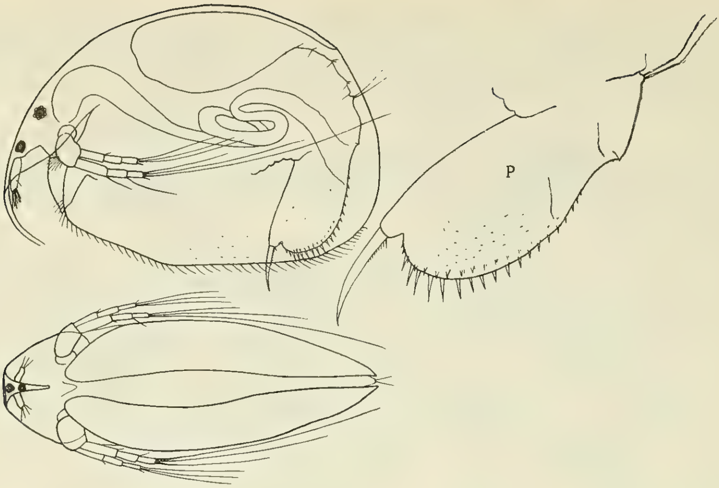

FIGURE 652. Leydigiopsis curvirostris, female (after Sars, 1901)

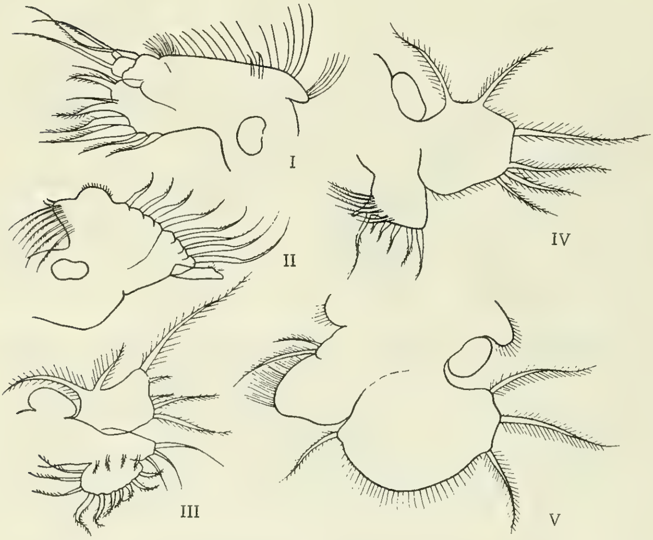

FIGURE 653. Legs of female of Leydigiopsis curvirostris (after Sars, 1901)

Nomen nudum

Monospilus świtezianus Dybowski and Grochowski, 1895:153.

26. Genus Leydigiopsis Sars, 1901

Sars, 1901:43.

Type species: Leydigiopsis curvirostris Sars, 1901.
Body oval. Head shield of female with long rostrum. According to the description of L. megalops, there are 2 main head pores with a broad connection between them (Goulden, 1966a). Antennules short, with obliquely truncate apex. Plate of labrum triangular. Postabdomen with a double row of anal spines and a row of lateral spinules on each side. Intestine with a double loop.

Five pairs of legs (Sars, 1901). Leg I of normal structure. Leg II with little differentiated hook-shaped setae on the endite. Leg III with a square exopodite with 5 setae on the posterior side and 2 setae on the dorsal side. Leg IV with a rounded exopodite with 6 setae. Leg V with a large exopodite with 4 setae, one on the anterior side and three on the posterior side.

Male. Smaller than the female, with modified leg I.

Key to Species of the Genus Leydigiopsis according to Females

1 (2). Rostrum very long, curved posteroventrally .... 1. **L. curvirostris** Sars, 1901.
2 (1). Rostrum longer than antennules by not more than their length.*
511 3 (6). Rostrum longer than antennules by 1.5 times their length.
4 (5). Ocellus smaller than eye .... 2. **L. brevirostris** Brehm, 1938.
5 (4). Ocellus larger than eye .... 3. **L. megalops** Sars, 1901.
6 (3). Rostrum longer than antennules by not more than their length ... . 4. **L. ornata** Daday, 1905.

1. **Leydigiopsis curvirostris** Sars, 1901 (Figures 652–655)

Sars, 1901:44–46, Plate VIII, Figures 1–11.

Material. According to description.

Female. Valves highest in the middle. Posterodorsal and posteroventral corner of valves rounded. Ventral margin of valves protruding before the middle. Rostrum very long, curved posteriorly. Fornices with slightly curved margin. Margin of valves with concentric rows of indistinct dots. Whole ventral margin of valves with setae. Antennae with a dense group of hairs on the basal segment. Endopodite slightly shorter than exopodite (when the antennae are directed posteriorly). The lower seta on the apical segment of the exopodite is longer than the two others and reaches to the posterior margin of the valve.

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* [There is apparently a mistake in the key. L. brevirostris has a short rostrum, "slightly longer than antennules" in the description.]

According to Brehm (1938a) the rostrum is 3 times as long as the antennules, i.e., distance from apex of antennule to apex of rostrum is twice as long as the antennule. Dorsal margin of postabdomen convex distal to the anus. Anal denticles 16–20, decreasing in size proximally. Distal end of postabdomen rounded. Preanal corner distinct. Claws with setae on the concave margin and with a basal denticle. Ocellus about as large as the eye. Leg II with uniform thin, hook-shaped setae. Leg III with a square exopodite with 2 setae on the dorsal side and 5 setae on the posterior side; the dorsal posterior seta twice as long as the others. Length 0.85 mm.

Male. Valves with rounded posterodorsal and posteroventral corner. Dorsal and ventral margin parallel. Rostrum shorter than in the female; antennules ending less than their length before apex of rostrum. Plate of labrum with pointed apex. Postabdomen not modified. Anterior side of endite of leg I with a brush of setae opposite the hook. Outer branch of endite of leg I with 3 thin setae. Ocellus nearly as large as eye. Length 0.62 mm.

Distribution. Brazil.

2. **Leydigiopsis brevirostris** Brehm, 1938 (Figure 656)

Brehm, 1938a:101–102, Figure 8.

Material. According to description.

Female. Rostrum short, slightly longer than antennules. Esthetascs slightly projecting beyond apex of rostrum. Anterior margin of labrum smooth, with two groups of setae. Claws with a row of setae on proximal quarter of concave margin, setae increasing in size distally, and with a thick, short, basal spine. Ocellus smaller than eye.

Male. Unknown.

Distribution. Brazil.

3. **Leydigiopsis megalops** Sars, 1901 (Figure 657)

Sars, 1901:46–47, Plate VIII, Figures 12–14; Goulden, 1966a:376–377, Plate 4, Figures D–H; 1966b:90.

Material. According to description.

Female. Posterodorsal corner of valves blunt. Posteroventral corner rounded, without spines. Valves with concentric rows of weak dots at the margin. Rostrum directed downward and slightly posteriorly. Head shield with rounded posterior margin and long (but not pointed) rostrum. Two broadly connected main head pores. Small pores situated near the main pores. According to Brehm (1938a) rostrum 1.5 times as long as the antennules, i.e., distance from base of antennules to apex of rostrum 1.5 times the length of the antennule. Antennae with distal setae of the same length. Plate of labrum with a denticle on the anterior margin. Dorsal margin of postabdomen straight, distal to the anus. Apex of postabdomen rounded, protruding. Postanal part of postabdomen 3 times as long as wide. Anal denticles 20, decreasing in size proximally. Groups of lateral setae present. Anal corner slightly protruding. Claws with setae on the concave margin. Ocellus 3 times as large as eye. Length 0.8 mm.

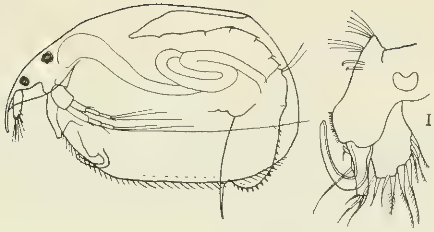

FIGURE 654. Leydigiopsis curvirostris, male (after Sars, 1901)

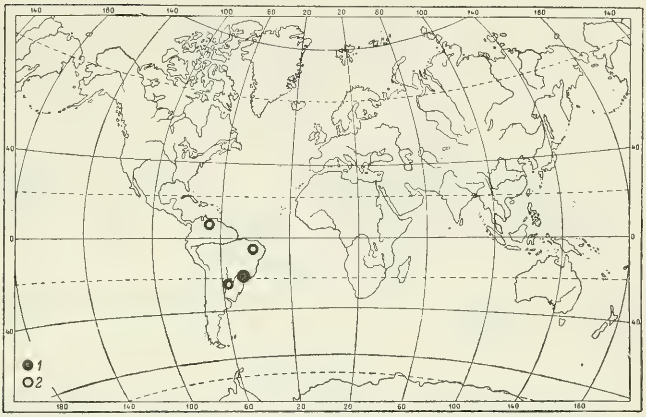

FIGURE 655. Distribution:

1 – Leydigiopsis curvirostris; 2 – L. ornata.

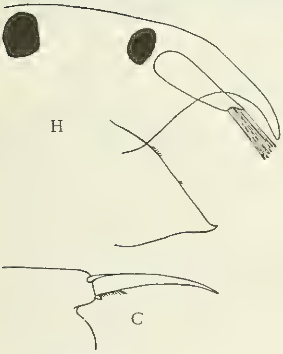

FIGURE 656. Leydigiopsis brevirostris, female (after Brehm, 1938a)

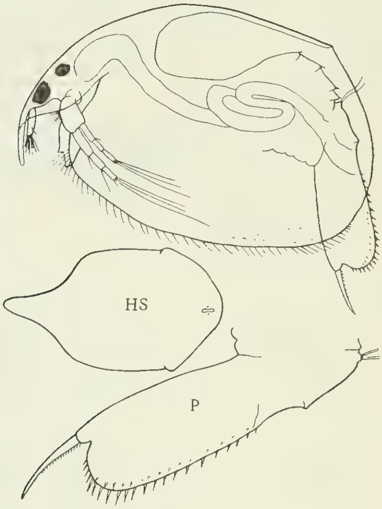

FIGURE 657. Leydigiopsis megalops, female, left side:

P – after Sars, 1901; HS – after Goulden, 1966a.

Male. Unknown.
Distribution. Brazil.

4. Leydigiopsis ornata Daday, 1905 (Figures 655, 658)

Daday, 1905:187–188, Plate XII, Figures 1, 2, 3; Brehm and Thomsen, 1936:211, 213, 217 (curvirostris); Brehm, 1937:510–511, Figures 6, 7; Goulden, 1966b:90–92, Plate I, Figure 7.

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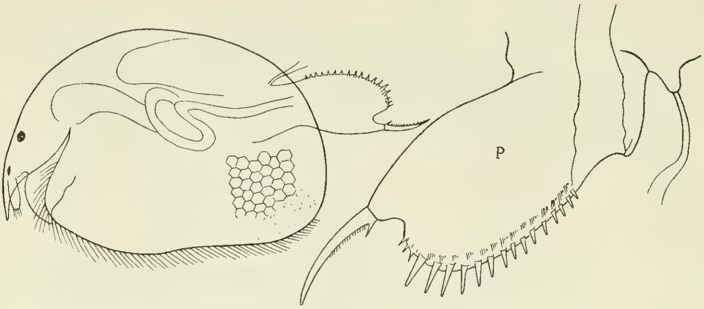

FIGURE 658. Leydigiopsis ornata, female (after Daday, 1905)

Material. According to description.
Female. Valves with rounded posterodorsal and posteroventral corner. Anterior and ventral margin with setae. Valve with pattern of hexagons with granules inside them. Periphery of valves with 2 concentric rows of granules without hexagons. Antennules almost reaching apex of rostrum. According to Brehm (1937, 1938a, 1956) the part of the postabdomen with spines is twice as long as wide. Anal denticles 13–16, with spines at the base. Claw with setae on the concave margin and with a row of setae at the base. Postabdomen with 14–15 anal denticles which become shorter proximally. Distal side of postabdomen with 3–4 spinules. Ten–twelve groups of setae laterally. Preanal corner distinct. Claws with setae in proximal half of concave margin and with a basal spine. Ocellus smaller than eye. Length to 0.63 mm.
Male. Unknown.
Distribution. Neotropical Region.

TAXA NOVA IN *CRUSTACEA* TOMO I FAUNAE URSS COMMEMORATA

GENUS NOVUM

Biapertura

SPECIES NOVAE

Biapertura longinqua
Biapertura pseudoverrucosa
Biapertura rigidicaudis
Camptocercus uncinatus
Chydorus brevidentatus
Kozhowia brevidentata

SUBSPECIES NOVAE

Alona pseudoverrucosa pseudoverrucosa
Chydorus eurynotus caelatus

MARES NOVI

Kozhowia gajewskajae
K. kozhowi
Kurzia longirostris

COMBINATIONES NOVAE

Acroperus titi
Alonella jugosa
A. unispina
A. reticulata
Biapertura affinis
B. intermedia
B. karua
B. pseudoverrucosa
Camptocercus rectirostris serratunguis
Chydorus breviceps
Ch. eurynotus brehmi
Ch. eurynotus reticulatus
Ch. nitidulus
Ch. sphaericus latus
Indialona annandalei
I. globulosa
I. macronyx
Oxyurella wallaciana
Pleuroxus laevis incertus
B. laevis pithyusus

SYNONYMA NOVA

Acroperus bairdi
Alona sp. Brehm, 1939
A. longirostris
A. minuta
A. stagnalis
A. whiteleggii
Alonella kulczinskii
Birgeia travassosi
Chydorus n. sp.? Brehm, 1936
Ch. denticulatus Henry
Ch. globiformis
Ch. lynceus
Ch. paradoxus
Ch. rylovi
Ch. pubescens
Ch. sphaericoides
Ch. tuberculatus
Ch. lynceus
Dunhevedia crassa var. interrupta
Lynceus Nargielewiczii
Monospilus cromaniensis
Phryxura
Ph. rectirostris
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P. bairdi Langhans
P. csikii
P. hamatus Baird
P. insigniter
P. sinkiangensis
P. transylvanus

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